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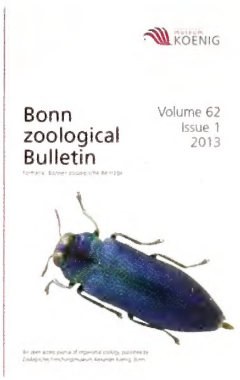

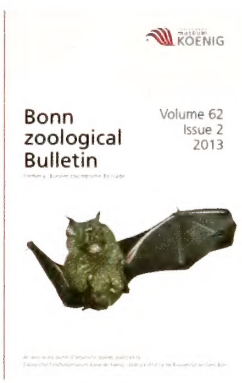

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On the *Nazeris* fauna of China II. New species and records from Zhejiang, Sichuan, and Yunnan (Coleoptera: Staphylinidae: Paederinae)

Volker Assing

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Abstract. Material of the Palaearctic paederine genus *Nazeris* Fauvel, 1873 from the Chinese provinces Zhejiang, Sichuan, and Yunnan is revised. Thirty species are described and illustrated, eight of them from Sichuan and the remainder from Yunnan: *Nazeris bilamellatus* sp. n. (Sichuan: Emei Shan); *N. foveatus* sp. n. (Sichuan: Erlang Shan); *N. appendiculatus* sp. n. (Sichuan: Daxue Shan); *N. puetzi* sp. n. (Sichuan: Erlang Shan); *N. cornutus* sp. n. (Sichuan: Erlang Shan); *N. trifurcatus* sp. n. (Sichuan: Xiaoxiang Ling); *N. wrasei* sp. n. (Sichuan: Xiaoxiang Ling); *N. schuelkei* sp. n. (Sichuan: Labahe, Daxiang Ling); *N. wuliangicus* sp. n. (Yunnan: Wuliang Shan and adjacent mountain range); *N. nivimontis* sp. n. (Yunnan: Xue Shan N Lincang); *N. sagittifer* sp. n. (Yunnan: Ailao Shan, Wuliang Shan); *N. secatus* sp. n. (Yunnan: Laobie Shan); *N. cangicus* sp. n. (Yunnan: Diancang Shan); *N. aculeatus* sp. n. (Yunnan: Jizu Shan); *N. zhemoicus* sp. n. (Yunnan: Zhemo Shan); *N. pungens* sp. n. (Yunnan: Xue Shan ENE Lincang); *N. lanuginosus* sp. n. (Yunnan: Laobie Shan); *N. peniculatus* sp. n. (Yunnan: mountain range N Er Hai); *N. barbatus* sp. n. (Yunnan: Wuliang Shan); *N. firmilobatus* sp. n. (Yunnan: Gaoligong Shan); *N. spiculatus* sp. n. (Yunnan: mountain range E Luxi); *N. curvus* sp. n. (Yunnan: Gaoligong Shan); *N. infractus* sp. n. (Yunnan: Nu Shan); *N. subdentatus* sp. n. (Yunnan: Gaoligong Shan); *N. meilicus* sp. n. (Yunnan: Meili Xue Shan); *N. vexillatus* sp. n. (Yunnan: Gaoligong Shan); *N. circumclusus* sp. n. (Yunnan: Gaoligong Shan); *N. hastatus* sp. n. (Yunnan: Gaoligong Shan); *N. bangmaicus* sp. n. (Yunnan: Bangma Shan); *N. fissus* sp. n. (Yunnan: Ailao Shan, Wuliang Shan). Records of 17 additional species are reported. Seven of them are represented exclusively by females and probably undescribed, and the remainder described previously; the latter are from Zhejiang (two species), Sichuan (four species), and Yunnan (four species). The male sexual characters of some of the previously described species are illustrated. Species group affiliations are discussed. The distributions of 37 species are mapped. The genus now includes a total of 171 species and seven subspecies; 94 species have been reported from China (exclusive of Taiwan).

Key words. Taxonomy, Staphylinidae, Paederinae, *Nazeris*, China, Zhejiang, Sichuan, Yunnan, new species, species groups, distribution maps, endemism.

INTRODUCTION

According to a recent contribution (Assing 2013a), the paederine genus *Nazeris* Fauvel, 1873 has an essentially Palaearctic distribution and previously comprised a total of 143 species and seven subspecies. As many as 66 species had been recorded from China (exclusive of Taiwan); two of them, however, are synonymous (see below). All the *Nazeris* species are flightless and, with one exception (*N. cultellatus* Assing, 2013), the species from China are locally endemic. In China, *Nazeris* ranks second among the paederine genera with respect to the diversity of micropterous species with restricted distributions, outnumbered in described species only by *Lathrobium* Gravenhorst, 1802, which is currently represented in China by 170 described species, most of them locally endemic (Assing 2013b, c, in press; Peng et al. 2013b). The provinces with the greatest diversity of previously described *Nazeris* species are Zhejiang (13 species), Yunnan (11), and Shaanxi (11), followed by Sichuan (9), Guangxi (6), Anhui (4), Gansu (3), Hubei (3), Chongqing (3), Jiangxi (2), Fujian (2), Xizang (2), Guizhou (1), and Henan (1). The sum of species exceeds 64 in this overview because five species have been reported from more than one province or from the border region between two or three provinces.

In all, 15 *Nazeris* species have been described from Zhejiang province (Assing 2013a; Hu et al. 2011a; Ito 1996; Koch 1939). However, according to a revision of type material by Hu (e-mail 12.7.2013), two of the names made available in Hu et al. (2011a) are junior synonyms, so that the *Nazeris* fauna of Zhejiang currently comprises 13 species.

The nine *Nazeris* species previously known from Sichuan were recorded from Wolong (one species), the Gongga Shan (two species), the Emei Shan (two species), the Micang Shan (one species), the Erlang Shan (one species), Labahe (one species), and from the Qingcheng Shan (one species whose description is based on a single female) (Assing 2013a; Hu et al. 2007; Zheng 1992). Regarding the type locality of one of these species, *N. canaliculatus* Zheng, the original description (Zheng1992)

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is contradictory. According to the Chinese description, all the type specimens are from the Emei Shan, whereas according to the English abstract, the holotype is from Wolong and the two female paratypes are from the Emei Shan. Most likely, the type locality given in the abstract is erroneous.

The *Nazeris* fauna of Yunnan previously comprised eleven species, four from the Gaoligong Shan, two from the Diancang Shan and the Laohu Shan, two from the Nabanhe Nature Reserve, and one each from the Yulongxue Shan, the Jizu Shan, and the Yuan Shan near Kunming (Hu et al. 2011b; Watanabe & Xiao 1993, 1997, 2000).

Recent studies on the Chinese *Lathrobium* fauna revealed that the diversity in Yunnan (60 described species) is far greater than that of any other province and that Sichuan (39 described species) ranks second (Assing 2013b, c; Peng et al. 2013a); among the remaining provinces the *Lathrobium* fauna of Shaanxi (20 described species) is the most diverse, but still hosts much fewer species than Yunnan and Sichuan. Since both *Lathrobium* and *Nazeris* have a similar distribution in the East Palaearctic and are often found in the same habitats, it seemed likely that the diversity trends observed for *Lathrobium* should also apply to *Nazeris*.

The present paper is based primarily on outstanding material from the collection of Michael Schülke (Berlin), most of which was collected by him and David Wrase (Berlin) during nine field trips to China in the past two decades. Additional material came from the collections of Aleš Smetana (Ottawa) and Andreas Pütz (Eisenhüttenstadt).

MATERIAL AND METHODS

The morphological studies were conducted using a Stemi SV 11 microscope (Zeiss Germany) and a Jenalab compound microscope (Carl Zeiss Jena). A digital camera (Nikon Coolpix 995) was used for the photographs. The maps were created using MapCreator 2.0 (primap) software.

Body length was measured from the anterior margin of the mandibles (in resting position) to the abdominal apex, the length of the forebody from the anterior margin of the mandibles to the posterior margin of the elytra, head length from the anterior margin of the frons to the posterior margin of the head, elytral length at the suture from the apex of the scutellum to the posterior margin of the elytra, and the length of the aedeagus from the apex of the ventral process to the base of the aedeagal capsule. The "parameral" side (i.e., the side where the sperm duct enters) is referred to as the ventral, the opposite side as the dorsal aspect.

For a discussion of the terminology of the aedeagal morphology see Assing (2009).

COLLECTION MATERIAL DEPOSITORIES

CAS	Chinese Academy of Sciences, Beijing
SMNS	Staatliches Museum für Naturkunde, Stuttgart (W. Schawaller)
ZFMK	Zoologisches Forschungsmuseum Alexander Koenig, Bonn
cAss	author's private collection
cPüt	private collection Andreas Pütz, Eisenhüttenstadt
cSch	private collection Michael Schülke, Berlin
cSme	private collection Aleš Smetana, Ottawa

RESULTS

Diversity and zoogeography

The revised material is composed of 47 species, ten of them described previously from Zhejiang (two species), Sichuan (four species), and Yunnan (four species). The localities where the material was collected are mapped in Fig. 1. Thirty species are newly described, eight from Sichuan and twenty-two from Yunnan. Seven additional, probably undescribed species remain unnamed since they were represented exclusively by females. Thus, including the new species described in this paper, *Nazeris* comprises a total of 171 species and seven subspecies, with 94 of them recorded from, and confined to, China. In all, 33 species are now known from Yunnan and 16 from Sichuan, the provinces with the most diverse *Nazeris* faunas. The diversity trends previously observed for *Lathrobium* are indeed paralleled by *Nazeris*.

Except for one species (*N. ruani*), all the species from Sichuan and Yunnan are locally endemic and known only from individual or adjacent mountain ranges.

As was observed earlier for the fauna of the Qinling Shan and the Daba Shan (Assing 2013a), closely related species, particularly hypothesized adelphotaxa, are generally at the same time geographically close, suggesting local speciation events. However, identifying phylogenetic relationships is significantly more difficult in *Nazeris* than in *Lathrobium*, particularly because the external and, even more importantly, the male sexual characters are less diverse. Nevertheless, it was possible to assign the majority of the species to species groups. For details see the introductions to the regional faunas of Sichuan and Yunnan below. Species of one species group generally have allopatric distributions (exceptions: *N. truncatus* and *N. bilamellatus* of the *N. truncatus* group in the Emei Shan, and *N. puetzi* and *N. foveatus* of the *N. hailuogouensis* group in the Erlang Shan), but often two or three species of different groups were recorded from the same mountain, not infrequently collected even in the same sample.

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Natural history

As can be inferred from the data specified on the labels of the material examined and as has been observed already for the *Nazeris* species of the Qinling Shan and the Daba Shan (Assing 2013a), the *Nazeris* species in the study regions live in the leaf litter and moss of various forest and shrub habitats. While the material from Zhejiang was collected at relatively low altitudes (300–1200 m), that from Sichuan and Yunnan came from significantly higher elevations. In Sichuan, the altitudes range from 1250 to 3250 m, with the vast majority of specimens found between 1600 and 3000 m. Only one species, *N. wrasei*, was observed at a lower (1250 m), and one probably undescribed species at a higher elevation (3250 m). In Yunnan, the altitudes range from 1900 to 3150 m, with only one species (*N. barbatus*) collected below 2100 m.

Species from Zhejiang

Nazeris rougemonti Ito, 1996

Material examined. China: Zhejiang: 5♂, 9♀, Tianmu Shan, pass 25 km NNW Linan, 30°26'N, 119°36'E, 620–820 m, stream valley with bamboo and mixed forest, litter sifted, 16.VI.2007, leg. Pütz, Schülke & Wrase (cPüt, cSch, cAss); 1♀, West Tianmu Shan N. R., trail to peak of immortals, 30°21'N, 119°26'E, 1100–1200 m, primary mixed forest, litter and moss sifted, 15.VI.2007, leg. Pütz (cPüt); 2♂, Tianmu Shan, 40 km WNW Linan, reservoir, 30°21'N, 119°19'E, 300 m, plant refuse and litter sifted, 17.VI.2007, leg. Schülke (cSch, cAss).

Comment. The original description of *N. rougemonti* is based on three type specimens from "Mt. Tienmushan" (Ito 1996). The known distribution is confined to the Tianmu Shan.

Nazeris chinensis Koch, 1939

Material examined. China: Zhejiang: 2♂, 1♀, West Tianmu Shan N. R., trail to peak of immortals, 30°21'N, 119°26'E, 1100–1200 m, primary mixed forest, litter and moss sifted, 15.VI.2007, leg. Pütz, Schülke & Wrase (cPüt, cSch, cAss).

Comment. *Nazeris chinensis* has been recorded from the Tianmu Shan and the Longwang Shan (Hu et al. 2011a).

Species from Sichuan

Species groups. Primarily based on the male sexual characters, the *Nazeris* fauna of Sichuan is represented by at least six species groups.

Nazeris dilatatus Assing, 2013 from the Micang Shan is the sole representative of the *N. shaanxiensis group* (see Assing 2013a) in Sichuan.

The evidently widespread *N. giganteus* group includes at least two species, *N. giganteus* from Yunnan and *N. ruani* from Sichuan. The species of this group are characterized by conspicuously large body size, a moderately deep V-shaped posterior excision of the male sternite VIII, and a rather large aedeagus with a slender and apically acute ventral process (ventral view) and with short, stout, curved, and apically dilated dorso-lateral apophyses. Based on the small median excision of the posterior margin of the male sternite VII, a characters otherwise seen only in *N. ruani*, the distinctly smaller *N. alpinus* from northern Yunnan may belong to this group, too. Unlike nearly all other Chinese representatives of the genus, *N. ruani* is not endemic to a single mountain range, but has a less restricted distribution (Fig. 28).

Nazeris magnus Hu et al., 2007 is the only species known from Sichuan that is of similarly large size as the species of the *N. giganteus* group, but it has an aedeagus of different morphology. Closer affiliations to other *Nazeris* species from Sichuan and Yunnan are not evident.

The *N. truncatus* group comprises six species from Sichuan, *N. truncatus*, *N. bilamellatus* (both from the Emei Shan), *N. bicornis* (Gongga Shan), *N. cornutus* (Erlang Shan), *N. trifurcatus* (Xiaoxiang Ling), and *N. folicaeus* Zheng, 1992 (Wolong). The species of this group are characterized by an aedeagus with two or three apical appendices of the ventral process of the aedagus, undoubtedly a synapomorphy. The posterior excision of the male sternite VIII is moderately deep, and the dorso-lateral apophyses are moderately long (reaching apex of ventral process at most, not extending beyond it).

The *N. hailuogouensis* group is represented in Sichuan by four species, *N. hailuogouensis* (Gongga Shan), *N. foveatus* (Erlang Shan), *N. appendiculatus* (Daxue Shan), and *N. puetzi* (Erlang Shan). The species of this group share a semi-membranous, short, ventrally sharply edged, and apically V-shaped (ventral view) ventral process of the aedeagus (e.g., Figs 5–6, 8–9, 13–14). The dorso-lateral apophyses extend far beyond the apex of the ventral process, and the posterior excision of the transverse male sternite VIII is rather deep and narrow (e.g., Figs 7, 12). *Nazeris hailuogouensis*, *N. foveatus*, *N. appendiculatus*, and *N. puetzi* are distinguished by clear-cut characters, but otherwise extremely similar, even in the male sexual characters. This observation suggests that speciation occurred in evolutionarily more recent times. Similar examples of closely related taxa have repeatedly been reported from

Fig. 1. Pooled examined records of *Nazeris* from the Chinese provinces Zhejiang (triangles), Sichuan (filled circles), and Yunnan (open circles). The frames illustrate the limits of the distribution maps for the individual species (Figs 28–29, 88–90).

the same region, e.g., for the genus *Othius* Stephens, 1829 (Staphylinidae: Othiini) (Assing 2003) or for some Lepidoptera (Lattin 1967). *Nazeris bicornis* and *N. cornutus* of the *N. truncatus* group (see above) represent another example of a pair of closely related *Nazeris* species occurring in the Gongga Shan and the Erlang Shan (like *N. hailuogouensis* and *N. foveatus*).

The *N. schuelkei* group includes two species, *N. schuelkei* (Labahe, Daxiang Ling) and *N. wrasei* (Xiaoxiang Ling). It is distinguished from the other species groups distributed in Sichuan by a stout and short aedeagus with a laterally compressed ventral process and with short and stout dorso-lateral apophyses (Figs 46–47, 52–53). The posterior excision of the male sternite VIII is rather broad and moderately deep (Figs 45, 51). Regarding the morphology of the ventral process of the aedeagus, the species of the *N. schuelkei* group are similar to the *N. cultellatus* group, which is distributed from the Qinling Shan eastwards to Henan and Anhui (see Assing 2013a).

The phylogenetic affiliations of *N. qingchengensis* Zheng, 1992 from the Qingcheng Shan (male unknown) and *N. canaliculatus* Zheng, 1992 from the Emei Shan (poorly illustrated) are uncertain.

***Nazeris ruani* Hu et al., 2007** (Fig. 28)

Material examined. China: Sichuan: 1♂, Emei Shan, 29°34'N, 103°21'E, 1800–2400 m, sifted, 27.VI.–5.VII.2009, leg. Grebennikov (cAss).

Comment. This species was described from Labahe, some 120 km to the northwest of the Emei Shan, suggesting that it is remarkably widespread (Fig. 28). The male sexual characters of the above male are identical to those illustrated by Hu et al. (2007: figures 15–19).

***Nazeris truncatus* Zheng, 1992** (Fig. 28)

Material examined. China: Sichuan: 1♂, 4♀, Emei Shan, 29°34'N, 103°21'E, 1950 m, sifted, 15.VI.2010, leg. Grebennikov (CAS, cSme, cAss); 4♂, 8♀, Emei Shan, 29°34'N, 103°21'E, 1800–2400 m, sifted, 27.VI.–5.VII.2009, leg. Grebennikov (CAS, cSme, cAss).

Comment. The known distribution of *N. truncatus*, a species characterized by an aedeagus of distinctive morphology (see figures 3B–C in Zheng 1992), is confined to the Emei Shan (Fig. 28).

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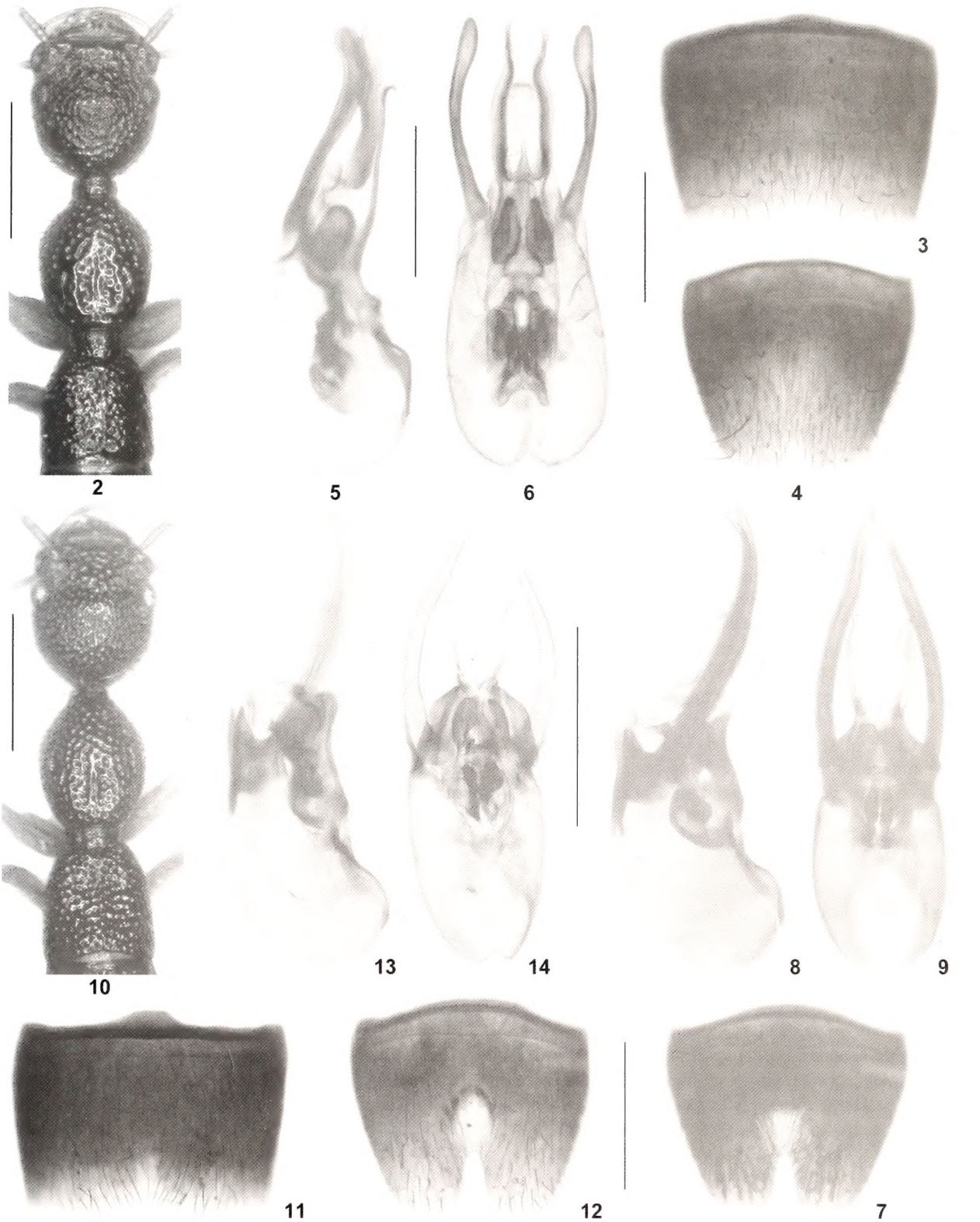

Figs 2–14. *Nazeris bilamellatus* (**2–6**), *N. hailuogouensis* (**7–9**), and *N. foveatus* (**10–14**). **2, 10:** forebody; **3, 11:** male sternite VII; **4, 7, 12:** male sternite VIII; **5–6, 8–9, 13–14:** aedeagus in lateral and in ventral view. Scale bars: 2, 10: 1.0 mm; 3–9, 11–14: 0.5 mm.

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***Nazeris bilamellatus* sp. n.** (Figs 2–6, 28)

Type material. Holotype ♂: "P.R. CHINA, Sichuan, Emei Shan, N29°33.6', E103°20.6', 27.vi.–5.vii.2009, 1800–2400 m, siftings 11–17, V. Grebennikov / Holotypus ♂ *Nazeris bilamellatus* sp. n. det. V. Assing 2013" (CAS). Paratypes: 2♂, 6♀: same data as holotype (CAS, cSme, cAss).

Etymology. The specific epithet (Latin, adjective: with two lamellae) alludes to the lamellate pair of apical processes of the ventral process of the aedeagus.

Description. Body length 5.7–7.3 mm; length of forebody 3.0–3.3 mm. Coloration: body dark–brown to blackish-brown; legs yellowish; antennae yellowish, with antennomere I usually slightly darker.

Head (Fig. 2) weakly oblong; punctation coarse, dense, and umbilicate; interstices without microsculpture; eyes of moderate size and distinctly convex, slightly more than one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 1.8 mm long.

Pronotum (Fig. 2) approximately 1.15 times as long as broad and 0.85–0.90 times as broad as head; punctation even coarser than that of head, non-umbilicate, and moderately dense; interstices narrower than diameter of punctures, glossy; midline punctate in anterior half, impunctate and somewhat elevated in posterior half; posterior half with a pair of lateral and somewhat irregularly oblique oblong elevations.

Elytra (Fig. 2) approximately 0.55 times as long as pronotum and slender; humeral angles obsolete; punctation dense, moderately defined, and coarse; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.30–1.35 times as broad as elytra; punctation dense, defined, and moderately coarse on tergite III, gradually becoming sparser towards posterior tergites, tergite VII with sparse punctation; interstices with shallow microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII distinctly convex.

♂: sternite VI–VII unmodified (Fig. 3); sternite VIII (Fig. 4) with unmodified pubescence, posterior excision small and V-shaped; aedeagus (Figs 5–6) rather large in relation to body size, 1.4–1.5 mm long; ventral process apically with pair of lamellate appendices; dorso-lateral apophyses curved, apically somewhat dilated and club-shaped, extending beyond apex of ventral process.

Comparative notes. Based on the morphology of the aedeagus (ventral process apically with pair of appendices; dorso-lateral apophyses club-shaped), *N. bilamellatus* is closely allied to *N. truncatus*, which too is distributed in the Emei Shan. It differs from this species by the much larger and differently shaped aedeagus (*N. truncatus*: aedeagus 0.9–1.0 mm long and with apical appendices of ventral process of completely different shape; apices of dorso-lateral apophyses far from reaching apex of ventral process), by slightly larger body size, and by the denser punctation of the posterior portion of the head and of the elytra. For illustrations of the aedeagus of *N. truncatus* see Zheng (1992).

Distribution and natural history. *Nazeris bilamellatus* is presumably endemic to the Emei Shan (Fig. 28), where the specimens were sifted from leaf litter at an altitude of 1800–2400 m, apparently together with *N. truncatus* and *N. ruani*.

***Nazeris hailuogouensis* Hu et al., 2007** (Figs 7–9, 28)

Material examined. China: Sichuan: 5♂, 3♀, Gongga Shan, Hailuogou Glacier Park, Camp 1, 29°36'N, 102°04'E, 2100 m, 27.–31.V.1997, leg. Pütz, Schülke & Wrase (cPüt, cSch, cAss); 1♂, 2♀, Gongga Shan, Hailuogou Glacier Park, Camp 2, 29°35'N, 102°02'E, 2550–2700 m, 30.–31.V.1997, leg. Pütz & Schülke (cPüt, cSch); 1♀, Gongga Shan, Hailuogou Glacier Park, above Camp 3, 3000 m, 30.V.1997, leg. Pütz (cPüt).

Comment. The original description of *N. hailuogouensis* is based on nine type specimens from Hailuogou in the Gongga Shan (Hu et al. 2007), where it is probably endemic (Fig. 28). The species is characterized particularly by the shape of the ventral process and the long and slender dorso-lateral apophyses of the aedeagus. The male sexual characters are illustrated in Figs 7–9.

***Nazeris foveatus* sp. n.** (Figs 10–14, 28)

Type material. Holotype ♂: "CHINA: W-Sichuan 1999, Ganzi Tibet. Aut. Pref., Luding Co., W Erlangshan-Pass, 2600 m, 7 km SSE Luding, 29°51N, 102°15E, Laub+ Nadelstreu, Pilze, 22.VI., leg. M. Schülke / Holotypus ♂ *Nazeris foveatus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 4♂, 2♀: "CHINA: W-Sichuan 1999, Ganzi Tibet. Aut. Pref., Luding Co., W Erlangshan-Pass, 2600 m, 7 km SSE Luding, 29°51N, 102°15E, Laubstreu, Pilze, 29.VI., leg. M. Schülke" (cSch, cAss); 1♂, 1♀: "CHINA W-Sichuan (Ganzi Tibet. Aut. Pref., Luding Co.) W Erlang Shan Pass, 2600 m, 7 km SSE Luding, 29°51N, 102°15E, Laubstreu, Pilze, 20.–29.VI.1999, D.W. Wrase" (cSch, cAss).

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Etymology. The specific epithet (Latin, adjective: with impression) alludes to the distinct impression of the male sternite VIII, one of the characters distinguishing this species from its closest relatives.

Description. Species of rather variable size; body length 5.5–7.5 mm; length of forebody 2.9–3.5 mm. Coloration: body blackish-brown to black; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 10) 1.08–1.15 times as long as broad; punctation coarse, dense, and weakly umbilicate; interstices without microsculpture; eyes small, distinctly less than one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna 1.7–2.0 mm long.

Pronotum (Fig. 10) 1.20–1.25 times as long as broad and approximately 0.9 times as broad as head; punctation distinctly coarser than that of head, non-umbilicate, and very dense; interstices forming narrow ridges, glossy; posterior half of midline narrowly elevated and impunctate.

Elytra (Fig. 10) approximately 0.6 times as long as pronotum and slender; humeral angles obsolete; punctation dense, defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen 1.20–1.25 times as broad as elytra; punctation dense, defined, and rather coarse on tergites III–VI, only indistinctly sparser and finer on tergite VII; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII distinctly convex.

♂: sternite VII with weakly concave posterior margin (Fig. 11); sternite VIII (Fig. 12) 1.10–1.15 times as broad as long, with distinct oblong and in the middle weakly sclerotized defined impression in postero-median portion; posterior excision rather deep and narrow, its depth approximately 0.3 times the length of sternite; aedeagus (Figs 13–14) slender, approximately 0.9 mm long (1.2 mm including dorso-lateral apophyses); ventral process weakly sclerotized, ventrally sharply edged, and with lateral lamellae forming a "V" in ventral view; basal portion of ventral process broad, without distinct lateral processes; dorso-lateral apophyses long and slender, distinctly extending beyond apex of ventral process.

Comparative notes. As can be inferred from the highly similar external and male sexual characters, particularly the similarly derived morphology of the aedeagus, this species is undoubtedly closely allied to *N. hailuogouensis* and the two following species. It differs from them particularly by the shape of the male sternite VIII (deeper and larger postero-median impression; this impression without pubescence and more extensively yellowish in the middle) and by the morphology of the aedeagus, in particular the shape of the ventral process (apical lamellae short, ventral portion broad and without lateral processes in ventral view). For illustrations of *N. hailuogouensis* see Figs 7–9 and figures 10–14 in Hu et al. (2007).

Distribution and natural history. The type locality is situated in the Erlang Shan, 7 km to the south-southeast of Luding, Sichuan (Fig. 28). The type specimens were sifted from the litter of broad-leaved and coniferous trees at an altitude of 2600 m, together with the holotype of *N. cornutus*.

Nazeris appendiculatus sp. n. (Figs 15–21, 28)

Type material. Holotype ♂: "CHINA: W-Sichuan (7), Daxue Shan, W Kangding, 30.03.13N, 101.57.11E, 2700–2800 m, 24.05.1997, M. Schülke / Holotypus ♂ *Nazeris appendiculatus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 1♂, 5♀: "CHINA: W-Sichuan (4), Daxue Shan, 2500–2800 m, Bachtal 5 km E Kangding, 30.03.28N, 102.00.15E, 20.05.1997, M. Schülke" (cSch, cAss); 2♀: "CHINA: W-Sichuan (4a), Daxue Shan, Bachtal 5 km E Kangding, 30.03.28N, 102.00.15E, 2500–2800 m, 23.05.1997, M. Schülke" (cSch); 1♂: "CHINA: (W Sichuan) (4), Daxue Shan, river valley 5 km E Kanding [sic], 30.03N, 102.00E, 20.&23.05.1997, Wrase" (cAss); 2♀: "CHINA: Sichuan, Ganzi pref., Daxue Shan, 102.00E, 30.03N, 5 km E Kangding, river valley, ca. 3000 m, 20.&23.V.1997, leg. A. Pütz" (cPüt); 1♂, 2♀: "CHINA: Sichuan, Ganzi pref., Daxue Shan, 101.57N, 30.03E, N Kangding, 2600–2700 m, 22.&24.V.1997, leg. A. Pütz" (cPüt, cAss).

Etymology. The specific epithet (Latin, adjective: with appendices) alludes to the distinctive baso-lateral projections (ventral view) of the ventral process of the aedeagus.

Description. Head with punctation not distinctly umbilicate. Other external characters (Fig. 15) as in *N. hailuogouensis* and *N. foveatus*.

♂: sternite VII (Fig. 16) with posterior margin moderately concave, particularly in the middle; sternite VIII (Fig. 17) approximately 1.05 times as broad as long, without distinct postero-median impression, posterior excision narrowly V-shaped, its depth approximately 0.23 times the length of sternite; aedeagus (Figs 18–21) slender, 0.87 mm long (approximately 1.1 mm including dorso-lateral apophyses); ventral process weakly sclerotized, ventrally sharply edged, and with lateral lamellae forming a "V" in ventral view; basal portion of ventral process slender, with a pair of distinct lateral projections; dorso-lateral apophyses long and slender, distinctly extending beyond apex of ventral process.

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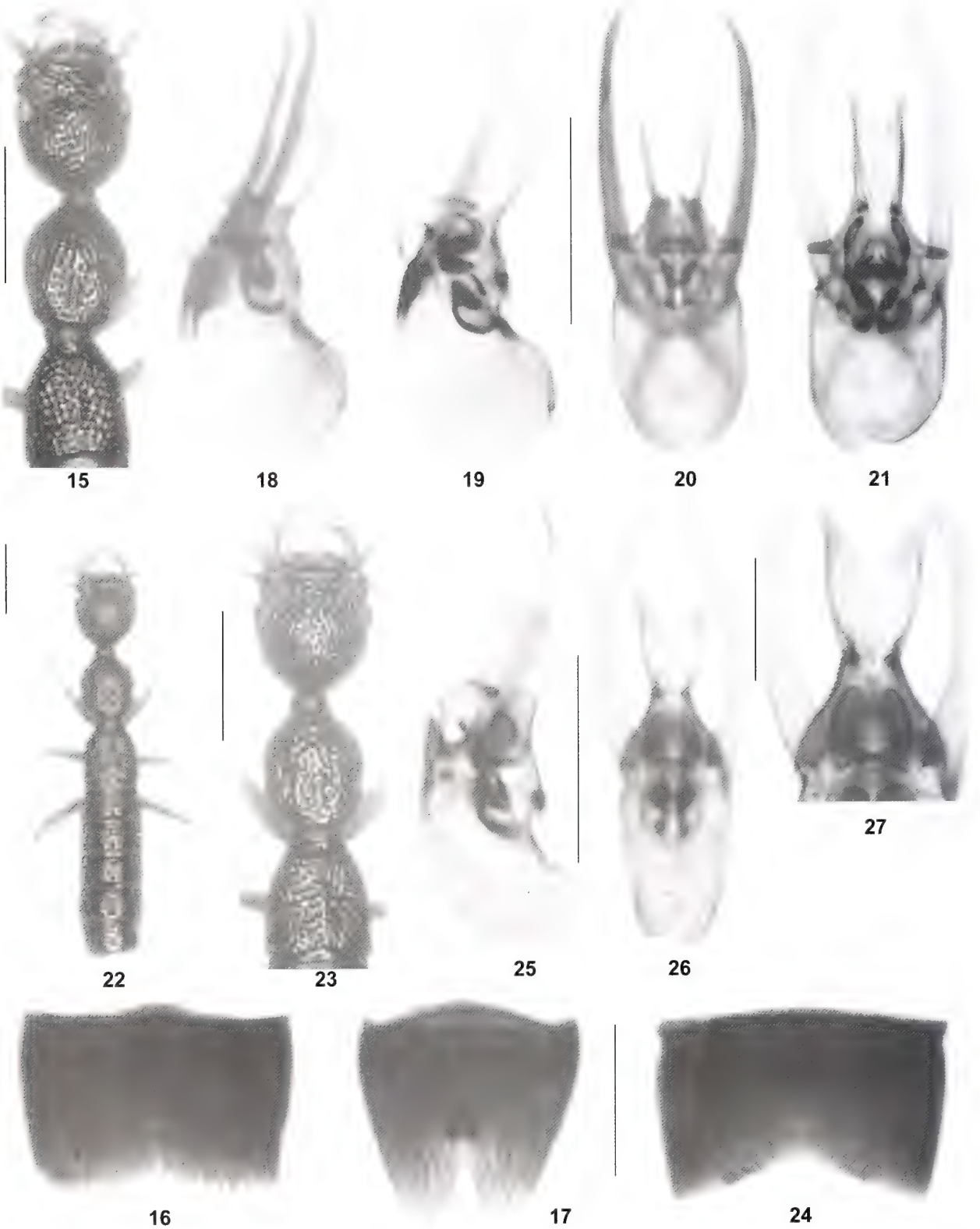

Figs 15–27. *Nazeris appendiculatus* (**15–21**), and *N. puetzi* (**22–27**). **15, 23:** forebody; **16, 24:** male sternite VII; **17:** male sternite VIII; **18–21, 25–26:** aedeagus in lateral and in ventral view; **22:** habitus; **27:** apical portion of median lobe of aedeagus in ventral view. Scale bars: 15, 22–23: 1.0 mm; 16–21, 24–26: 0.5 mm; 27: 0.2 mm.

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Comparative notes. *Nazeris appendiculatus* undoubtedly belongs to the group of species allied to *N. hailuogouensis*, as is suggested particularly by the similarly derived morphology of the aedeagus. It is distinguished from the two preceding species of this group by the non-umbilicate punctation of the head, the less deep and relatively broader posterior excision of the male sternite VIII, the absence of a distinct postero-median impression of the male sternite VIII, and the morphology of the aedeagus (median lobe of aedeagus relatively longer and of different shape in lateral view, basally with pair of conspicuous projections in ventral view).

Distribution and natural history. The species was discovered in three localities in the Daxue Shan in the environs of Kangding, Sichuan (Fig. 28), at altitudes between 2600 and approximately 3000 m. Additional data are not available

***Nazeris puetzi* sp. n.** (Figs 22–28, 41)

Type material. Holotype ♂: "CHINA: W-Sichuan, Ya'an Prefecture, Tianquan Co., W Erlang Shan Pass / 2900 m, 21.VI.1999, 29.51.13N, 102.17.28E, leg. A. Pütz, sifted / Holotypus ♂ *Nazeris puetzi* sp. n. det. V. Assing 2013" (cAss).

Etymology. The species is dedicated to Anreas Pütz, specialist of Byrrhidae, who collected the holotype.

Description. Habitus as in Fig. 22. Head with punctation not distinctly umbilicate (Fig. 23). Other external characters as in *N. hailuogouensis* and *N. foveatus*.

♂: sternite VII (Fig. 24) strongly transverse, posterior margin distinctly concave; sternite VIII (Fig. 41) 1.17 times as broad as long, without distinct postero-median impression, posterior excision narrowly V-shaped, its depth approximately 0.3 times the length of sternite; aedeagus (Figs 25–27) slender, 0.87 mm long (1.08 mm including dorso-lateral apophyses); ventral process weakly sclerotized, ventrally sharply edged, and with lateral lamellae forming a "V" in ventral view; basal portion of ventral process moderately broad, without lateral projections; dorso-lateral apophyses long and slender, distinctly extending beyond apex of ventral process.

Comparative notes. *Nazeris puetzi*, too, clearly belongs to the group of species allied to *N. hailuogouensis*. It is distinguished from *N. foveatus*, another species of this group probably endemic to the Erlang Shan, by the non-umbilicate punctation of the head, the distinctly concave posterior margin of the more transverse male sternite VII, the shape of the male stenite VIII (without distinct postero-median impression, posterior excision broad), and the morphology of the aedeagus (basal portion of ventral process more slender in ventral view; apical portion of ventral process longer; lateral aspect of ventral process of different shape).

Distribution and natural history. The type locality is situated in the Erlang Shan in W-Sichuan (Fig. 28). The holotype was sifted from leaf litter at an altitude of 2900 m.

***Nazeris bicornis* Hu et al., 2007** (Fig. 29)

Material examined. China: Sichuan: 1♂, 2♀, Gongga Shan, Hailuogou Glacier Park, Camp 1, 29°36'N, 102°04'E, 2100 m, 27.–31.V.1997, leg. Schülke & Wrase (cSch, cAss); 1♀, Gongga Shan, Hailuogou Glacier Park, Camp 2, 29°35'N, 102°02'E, 2550–2700 m, 30.–31.V.1997, leg. Schülke (cSch).

Comment. *Nazeris bicornis* is known only from the Gongga Shan (Fig. 29); its original description is based on eight type specimens from Hailuogou. Based on the morphology of the aedeagus (ventral process apically with a pair of processes), it is closely allied to *N. truncatus* and *N. bilamellatus*.

***Nazeris cornutus* sp. n.** (Figs 29, 30–34)

Type material. Holotype ♂: "CHINA: W-Sichuan 1999, Ganzi Tibet. Aut. Pref., Luding Co., W Erlangshan-Pass, 2600 m, 7 km SSE Luding, 29°51N, 102°15E, Laubstreu, Pilze, 29.VI., leg. M. Schülke / Holotypus ♂ *Nazeris cornutus* sp. n. det. V. Assing 2013" (cAss).

Etymology. The specific epithet (Latin, adjective: with horns) alludes to the horn-shaped apices of the ventral process of the aedeagus and the evident close relationship with *N. bicornis*.

Description. Body length 6.0 mm; length of forebody 2.9 mm. Habitus as in Fig. 30. Coloration: body blackish-brown; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 31) 1.08 times as long as broad; punctation coarse, very dense, and umbilicate; interstices without microsculpture; eyes moderately small, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna 1.6 mm long.

Pronotum (Fig. 31) 1.2 times as long as broad and 0.9 times as broad as head; punctation somewhat coarser than that of head, non-umbilicate, and moderately dense; interstices distinctly narrower than diameter of punctures, glossy; posterior half of midline narrowly elevated and impunctate.

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Fig. 28. Distributions of *Nazeris* species in Sichuan: *N. truncatus* (filled star); *N. bilamellatus* (filled star); *N. ruani* (filled star: examined record; open star: type locality); *N. hailuogouensis* (filled triangles); *N. foveatus* (filled circle); *N. appendiculatus* (diamonds); *N. puetzi* (open triangle).

Elytra (Fig. 31) 0.58 times as long as pronotum and slender; humeral angles obsolete; punctation dense, defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen 1.2 times as broad as elytra; punctation dense, defined, and rather coarse on anterior tergites, gradually becoming sparser and finer towards posterior tergites, rather sparse and fine on tergite VII; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII convex.

♂: sternite VII unmodified; sternite VIII (Fig. 32) 1.05 times as broad as long, posterior excision V-shaped and rather small, its depth approximately 0.18 times the length of sternite; aedeagus (Figs 33–34) slender, 1.05 mm long; ventral process apically with pair of curved and apically acute horn-shaped processes in ventral view; dorso-lateral apophyses long and slender, apically just reaching apices of ventral process.

Comparative notes. As can be inferred from the similar external and male sexual characters, particularly the similarly derived morphology of the aedeagus, this species is undoubtedly closely allied to *N. bicornis*, from which it differs by the slightly denser punctation of the abdomen, the smaller posterior excision of the male sternite VIII, and by the distinctly smaller and differently shaped aedeagus (ventral process basally more slender; apical processes of ventral process shorter and apically less acute; dorso-lateral apophyses more slender; internal structures of different shape). The aedeagus of *N. bicornis* is 1.2 mm long; for illustrations of the male sternite VIII and the aedeagus of *N. bicornis* see figures 6–9 in Hu et al. (2007).

Distribution and natural history. The type locality is situated in the Erlang Shan, 7 km to the south-southeast of Luding, Sichuan (Fig. 29). The holotype was sifted from leaf litter at an altitude of 2600 m, together with *N. foveatus*.

Nazeris trifurcatus sp. n. (Figs 29, 35–40)

Type material. Holotype ♂: "CHINA: S-Sichuan 1999, Ya'an Prefecture, Shimian Co., Xiaoxiang Ling, 7 km S Liziping, 35 km S Shimian, 28°56N, 102°18E, ca. 1600 m, Bambus, Feldrand, 7.VII., leg. M. Schülke / Holotypus ♂ *Nazeris trifurcatus* sp. n. det. V. Assing 2013" (cAss).

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Fig. 29. Distributions of *Nazeris* species in Sichuan: *N. bicornis* (triangles); *N. cornutus* (filled circle); *N. infurcatus* (star); *N. wrasei* (diamond); *N. schuelkei* (open circles).

Etymology. The specific epithet is an adjective composed of the Latin prefix tri- (three) and an adjective derived from the Latin noun furca (fork). It alludes to the trifurcate apex of the ventral process of the aedeagus.

Description. Body length 6.0 mm; length of forebody 3.1 mm. Habitus as in Fig. 35. Coloration: body blackish-brown; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 36) 1.08 times as long as broad; punctation coarse, dense, and umbilicate; interstices without microsculpture; eyes small, less than one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna 1.8 mm long.

Pronotum (Fig. 36) 1.20 times as long as broad and 0.93 times as broad as head; punctation even coarser than that of head, non-umbilicate, and moderately dense; interstices distinctly narrower than diameter of punctures, glossy; midline punctate in anterior half, impunctate and somewhat elevated in posterior half; posterior half with a pair of somewhat irregular glossy oblong elevations.

Elytra (Fig. 36) 0.6 times as long as pronotum and slender; humeral angles obsolete; punctation dense, moderately defined, and nearly as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen 1.25 times as broad as elytra; punctation dense, defined, and moderately coarse on tergites III-IV, sparser on tergite V, gradually becoming sparser towards posterior tergites, tergite VII with sparse punctation; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII distinctly convex.

♂: sternite VII unmodified (Fig. 37); sternite VIII (Fig. 38) weakly oblong with unmodified pubescence, posterior excision V-shaped, 0.17 times as deep as length of sternite; aedeagus (Figs 39–40) slender, 1.1 mm long; ventral process apically trifurcate, with the median process distinctly shorter than the lateral ones; dorso-lateral apophyses curved, weakly dilated in apical half, and not reaching apex of ventral process.

Comparative notes. *Nazeris trifurcatus* is distinguished from all its congeners by the male sexual characters, particularly the trifurcate apex of the ventral process of the aedeagus. The latter suggests that the species may be closely related to *N. bicornis* and allied species.

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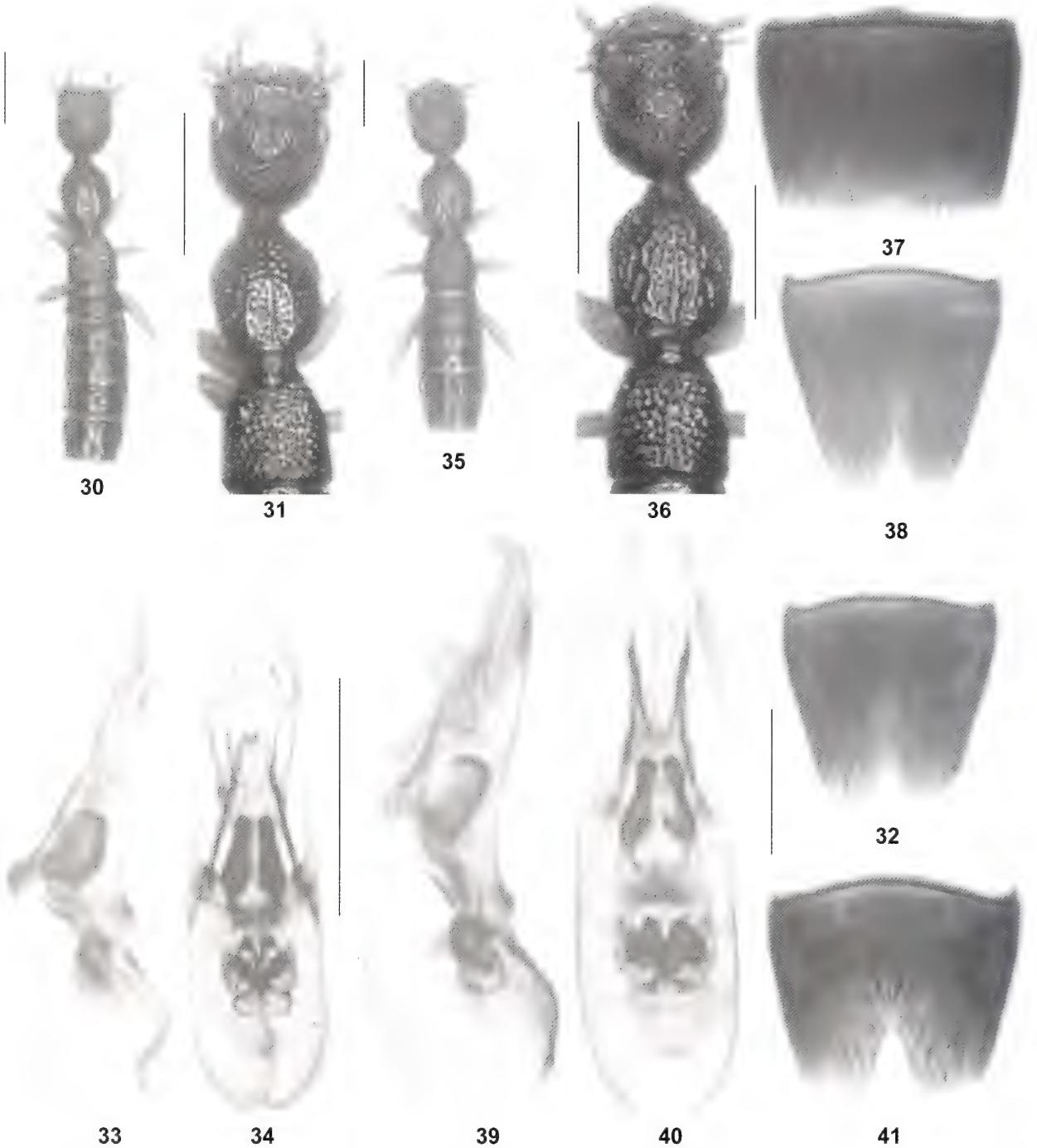

Figs 30–41. *Nazeris cornutus* (**30–34**), *N. trifurcatus* (**35–40**), and *N. puetzi* (**41**). **30, 35:** habitus; **31, 36:** forebody; **32, 38, 41:** male sternite VIII; **33–34, 39–40:** aedeagus in lateral and in ventral view; **37:** male sternite VII. Scale bars: 30–31, 35–36: 1.0 mm; 32–34, 37–41: 0.5 mm.

Distribution and natural history. The type locality is situated to the south of Shimian in southern Sichuan (Fig. 29). The holotype was collected in a field margin with bamboo at an altitude of approximately 1600 m.

***Nazeris wrasei* sp. n.** (Figs 29, 42–47)

Type material. Holotype ♂: "CHINA S.Sichuan (Ya'an Pref., Shimian Co.), Xiaoxiang Ling, side-valley above Nanya Cun nr. Caluo, 11 km S Shimian, ca. 1250 m,

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7.VII.1999, D.W. Wrase / Holotypus ♂ *Nazeris wrasei* sp. n. det. V. Assing 2013" (cAss). Paratypes: 1♀: same data as holotype (cSch); 2♀: "CHINA: W-Sichuan, Ya'an Pref., Shimian Co., Xiaoxiang Ling, side-valley ab. Nanya Cun nr. Caluo, 11 km S Shimian, 1250 m, 7.VII.1999, leg. A. Pütz" (cPüt, cAss).

Etymology. The species is dedicated to my friend David Wrase (Berlin), specialist of Carabidae, who collected two of the type specimens.

Description. Body length 4.7–5.2 mm; length of forebody 2.5–2.7 mm. Habitus as in Fig. 42. Coloration: body blackish-brown; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 43) approximately 1.05 times as long as broad; punctation moderately coarse, very dense, and umbilicate; interstices without microsculpture; eyes moderately small, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 1.5 mm long.

Pronotum (Fig. 43) approximately 1.15 times as long as broad and 0.95 times as broad as head; punctation distinctly coarser than that of head, non-umbilicate, and moderately dense; interstices distinctly narrower than diameter of punctures, glossy; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 43) approximately 0.55 times as long as pronotum; humeral angles obsolete; punctation dense, moderately defined, and distinctly less coarse than that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen 1.20–1.25 times as broad as elytra; punctation dense, defined, and moderately coarse on anterior tergites; sparser and finer on tergite VII; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII weakly convex.

♂: sternite VII (Fig. 44) with truncate posterior margin and with a transverse series of long submarginal setae, otherwise unmodified; sternite VIII (Fig. 45) approximately as long as broad, posterior excision anteriorly rounded (not acute) and approximately 0.2 times as deep as length of sternite; aedeagus (Figs 46–47) stout, 0.85 mm long; ventral process apically concave in ventral view; dorso-lateral apophyses stout and strongly sclerotized, slightly extending beyond apex of ventral process.

Comparative notes. The morphology of the aedeagus is somewhat similar to that of species of the *N. cultellatus* group (Assing 2013a), but the ventral process is less distinctly compressed laterally and, unlike the species of the *N. cultellatus* group, the punctation of the head is umbilicate. From the species previously recorded from Sichuan, *N. wrasei* is readily distinguished by the stouter aedeagus.

Distribution and natural history. The type locality is situated to the south of Shimian in southern Sichuan (Fig. 29). The type specimens were collected at an altitude of approximately 1250 m.

***Nazeris schuelkei* sp. n.** (Figs 29, 48–53)

Type material. Holotype ♂: "CHINA: W-Sichuan 1999, Ya'an Prefecture, Tianquan Co., Jiajin Shan, Tal oberh. Labahe N.R. St., 57 km W Ya'an, 30°06N, 102°25E, Streu, Rinde, Pilze, 1800 m, 12.VII., leg. M. Schülke / Holotypus ♂ *Nazeris schuelkei* sp. n. det. V. Assing 2013" (cAss). Paratypes: 2♂: same data as holotype (cSch); 1♂: "CHINA: W-Sichuan 1999, Ya'an Prefecture, Fulin Co., Daxiang Ling, Rd. zw. Hanyuanjie u. Siping, 51 km NNE Shimian, 2300 m, 29°39N, 102°37E, Ufer, Gesiebe, 10.VII., leg. M. Schülke" (cAss); 1♀: "CHINA: W-Sichuan, Ya'an Pref., Fulin Co., Daxiang Ling, pass N / Hanyuanjie, 51 km NNE Shimian, smal [sic] stream, 29.39N, 102.37E, 2300 m, 10.VII.1999, leg. A. Pütz" (cPüt).

Etymology. The species is dedicated to my friend and colleague Michael Schülke, who collected most of the type specimens and whose material the present paper is largely based on.

Description. Body length 5.0–5.7 mm; length of forebody 2.6–2.9 mm. Habitus as in Fig. 48. Coloration: body dark-brown to blackish-brown; legs yellowish; antennae yellowish, with antennomere I slightly darker. Abdomen with microsculpture. Other external characters (Fig. 49) as in *N. wrasei*.

♂: sternite VII (Fig. 50) with truncate posterior margin and with a transverse series of moderately long submarginal setae, otherwise unmodified; sternite VIII (Fig. 51) approximately 1.1 times as broad as long, posterior excision anteriorly narrowly rounded (not acute) and approximately 0.2 times as deep as length of sternite; aedeagus (Figs 52–53) stout, 0.85 mm long; ventral process apically acute in ventral view; dorso-lateral apophyses stout and strongly sclerotized, subbasally somewhat dilated, distinctly converging in ventral view, and extending nearly to apex of ventral process.

Comparative notes. The similar external and male sexual characters suggest that *N. schuelkei* is closely related to the geographically close *N. wrasei*, from which it is distinguished particularly by the presence of microsculpture on the abdomen, by the different shape of the male sternite VIII, and by the morphology of the aedeagus (shapes of ventral process and of dorso-lateral apophyses).

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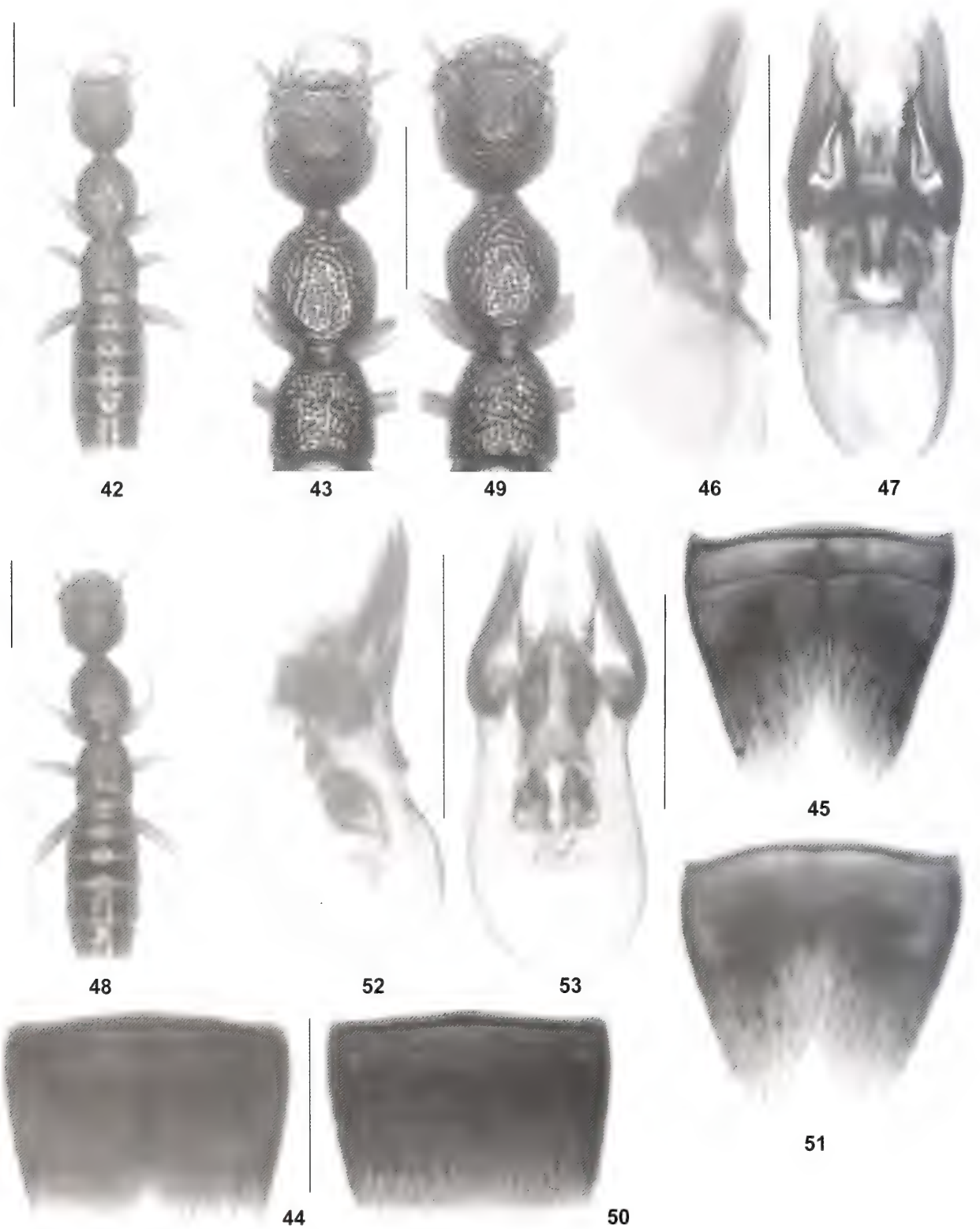

Figs 42–53. *Nazeris wrasei* **(42–47)** and *N. schuelkei* **(48–53). 42, 48:** habitus; **43, 49:** forebody; **44, 50:** male sternite VII; **45, 51:** male sternite VIII; **46–47, 52–53:** aedeagus in lateral and in ventral view. Scale bars: 42–43, 48–49: 1.0 mm; 44–47, 50–53: 0.5 mm.

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Distribution and natural history. The species was discovered in two localities in Ya'an Prefecture, West Sichuan (Fig. 29). The specimens were sifted from litter, in one locality near a stream bank, at altitudes of 1800 and 2300 m.

Unnamed and presumably undescribed species

Three probably undescribed species remain unnamed since they are represented in the examined material exclusively by females.

Nazeris sp. 1: 1♀: "CHINA – W-Sichuan, Ya'an Pref., Shimian Co., Xiaoxiang Ling, Pass betw. Shimian-Ganluo, 27 km SE Shimian, 2450 m, springfed-swamp, 29.02.75N, 102.31.48E, 8.VII.1999, leg. A. Pütz" (cPüt).

This large species is distinguished from the similarly large *N. ruani* by more slender body, a more elongate head, distinctly coarser and non-umbilicate punctation of the head, and the coarser punctation of the abdomen. The only other species of similar size known from Sichuan is *N. magnus* Hu et al., 2007, which was described from the Erlang Shan. Judging from the habitus photo provided by Hu et al. (2007), *N. magnus* appears to have a more densely punctate head and pronotum.

Nazeris sp. 2: 1♀: "CHINA W.Sichuan (Ganzi Tibet. Aut. Pref., Yajiang Co.), Shalui Shan, river valley 6 km WSW Yajiang, 3250 m, 30°01N, 102°57E (river bank, bank slope), 4.VII.1999 D.W. Wrase" (cSch).

This moderately large, black species is distinguished from most geographically close congeners by the non-umbilicate punctation of the head. Based on the external characters, it may belong to the *N. hailuogouensis* group.

Nazeris sp. 3: 1♀: "CHINA NW Sichuan, 20 km NW Maowen, 2150 m, Jiuding Shan, coniferous wood, 7–28.VI.2004, leg. R. Fabbri" (cSch).

Species from Yunnan

Species groups. The *N. giganteus* group is represented in Yunnan by *N. giganteus* (Diancang Shan) and possibly the distinctly smaller *N. alpinus* (Yulongxue Shan). This group also includes *N. ruani* from Sichuan, most likely the adelphotaxon of *N. giganteus*. For more details see the section on the species groups of Sichuan.

The *N. daliensis* group comprises at least five species, *N. daliensis* (Diancang Shan), *N. jizushanensis* (Jizu Shan), *N. wuliangicus* (Wuliang Shan and adjacent mountain range), *N. sagittifer* (Wuliang Shan, Ailao Shan), and *N. nivimontis* (Xue Shan N Lincang). This species group is constituted particularly by the derived morphology of the aedeagus (ventral process short, weakly sclerotized, more or less sharply edged ventrally; dorso-lateral apophyses long and slender, extending far beyond apex of the ventral process) (e.g., Figs 58–59, 62–63, 65–66). The male posterior incision of the male sternite VIII is relatively small, 0.25 times as deep as the sternite at most (e.g., Figs 57, 69, 73, 75), and the male sternite VII is weakly modified at most (posterior margin truncate to moderately concave in the middle) (e.g., Figs 68, 72, 74).

The *N. vexillatus* group includes three species, all of them distributed in the Gaoligong Shan: *N. vexillatus*, *N. circumclusus*, and *N. hastatus*. They are characterized by an aedeagus with a short ventral process and with modified (dilated or with processes) dorso-lateral apophyses extending far beyond the apex of the ventral process of the median lobe (Figs 180–181, 187–188, 193–194). The male sternite VII is weakly modified (e.g., Figs 185, 191) and the body colour is brown to dark-brown, but not black.

The *N. fissus* group is composed of two species, *N. fissus* (Wuliang Shan, Ailao Shan) and *N. caoi* Hu et al., 2011 (Nabanhe Nature Reserve). This group is constituted by a conspicuous synapomorphy, a completely divided (bifid) ventral process of the aedeagus (Figs 205–206).

The male sexual characters of *N. secatus* (Laobie Shan) and *N. bangmaicus* (Bangma Shan) do not suggest closer affiliations to any of the other species known from Yunnan.

The remaining species are - partly tentatively - assigned to the *N. cangicus* group. They are characterized by an aedeagus with a more or less slender and apically acute ventral process (e.g., Figs 96–97, 102–103), usually unmodified dorso-lateral apophyses not extending distinctly beyond the apex of the ventral process of the median lobe (exceptions: *N. pungens*, *N. lanuginosus*), a more or less distinctly modified male sternite VII (often with a postero-median impression, a medially concave posterior margin, and/or modified pubescence) (e.g., Figs 94, 100), and a male sternite VIII with a usually deep and narrow posterior excision (often also with an oblong median impression) (e.g., Figs 95, 101). The colour of the body of mature specimens is usually blackish. Based on the illustrations provided in their respective original descriptions, *N. zhangi* Watanabe & Xiao, 1993 (Yu'an Shan near Kunming), *N. baihuaensis* Watanabe & Xiao, 2000 (Gaoligong Shan), *N. nomurai* Watanabe & Xiao, 2000 (Gaoligong Shan), *N. huanxipoensis* Watanabe & Xiao, 2000 (Gaoligong Shan), *N. ishiianus* Watanabe & Xiao, 2000 (Gaoligong Shan), and *N. nabanhensis* Hu et al., 2011 (Nabanhe Nature Reserve) may belong to the *N. cangicus* group, too. Within this group, two species pairs were identified. One of them is represented by *N. pungens* (Xue Shan N Lincang) and *N. lanuginosus* (Laobie Shan), both of which have a male sternite VII with a posterior cluster of long black setae (Figs 113, 119) and an aedeagus

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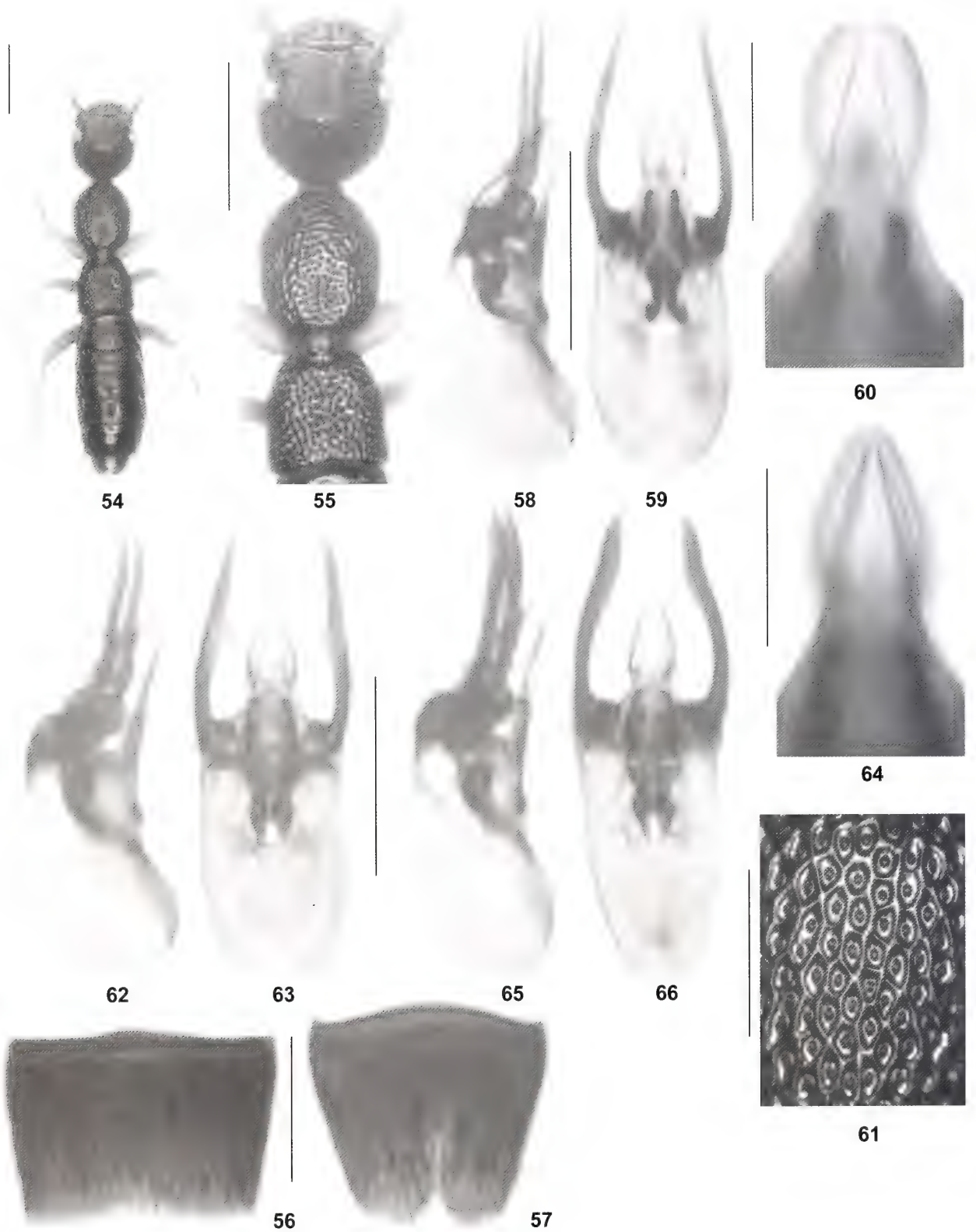

Figs 54–66. *Nazeris wuliangicus* (**54–60**), *N. daliensis* (**61–64**), and *N. jizushanensis* (**65–66**). **54:** habitus; **55:** forebody; **56:** male sternite VII; **57:** male sternite VIII; **58–59, 62–63, 65–66:** aedeagus in lateral and in ventral view; **60, 64:** ventral process of aedeagus in ventral view; **61:** median dorsal portion of head. Scale bars: 54–55: 1.0 mm; 56–59, 62–63, 65–66: 0.5 mm, 60–61, 64: 0.2 mm.

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with the dorso-lateral apophyses extending far beyong the apex of the ventral process (Figs 115–116, 121–122). The other species pair comprises *N. peniculatus* (mountain range N Er Hai) and *N. barbatus* (Wuliang Shan), whose male sternites VII share a unique synapomorphy, a cluster of modified stout black setae (Figs 118, 133).

***Nazeris giganteus* Watanabe & Xiao, 1997** (Fig. 90)

Material examined. China: Yunnan: 1♀, Dali Bai Aut. Pref., Diancang Shan, 3 km W Dali old Town, "cloud road", 25°41'N, 100°07'E, 2750 m, pine forest with broadleaved undergrowth and bamboo, vinegar trap, 17.–23.VI.2005, leg. Wrase (cAss).

Comment. This large species was described based on three specimens from "Qinghi Xi, Diancang Shan Mts." and one male from "Mt. Laohu Shan, Dali Shi" (Watanabe & Xiao 1997). The above specimen is a female, but no other species of similar size are known from the Diancang Shan. Aside from the conspicuously large body size, *N. giganteus* shares similarly derived male characters with *N. ruani* from Sichuan (see the section on the species groups occurring in Sichuan). The above record is mapped in Fig. 90.

***Nazeris alpinus* Watanabe & Xiao, 1997** (Fig. 88)

Material examined. China: Yunnan: 2♂, 7♀, Lijiang Naxi Aut. Co., E Yulongxue Shan, 30 km N Lijiang, 27°09'N, 100°15'E, 2800–2900 m, secondary mixed forest, 13.VIII.2003, leg. Smetana & Wrase (cSch, cSme, cAss); 1♀, 26 km N Lijiang, Ganhaizi pass, 27°07'N, 100°15'E, 3000 m, mixed coniferous forest, litter and moss under rhododendron sifted, 15.VI.2007, leg. Hájek & Růžička (cAss).

Comment. The original description of *N. alpinus* is based on nine type specimens from the Yulongxue Shan (Watanabe & Xiao 1997), where this species is probably endemic. The phylogenetic affiliations are unclear. Based on the short, strongly curved, and strongly sclerotized dorso-lateral apophyses and the presence of a minute median incision of the posterior margin of the male sternite VII (a character otherwise observed only in *N. ruani*), *N. alpinus* is tentatively attributed to the *N. giganteus* group. The above records are mapped in Fig. 88.

***Nazeris daliensis* Watanabe & Xiao, 1997** (Figs 61–64, 72–73, 88)

Material examined. China: Yunnan: 4♀, Dali Bai Aut. Pref., Diancang Shan, 5 km SSW Dali, 25°39'N, 100°08'E, 2800 m, 26.VIII.2003, leg. Schülke, Smetana, Wrase (cSch, cSme, cAss); 1♂, 2♀ [all teneral], Diancang Shan, 3 km W Dali, 25°41'N, 100°07'E, 2600–2650 m, 30.VIII.2003, leg. Smetana (cSme); 1♂, 1♀ [1 teneral], Diancang Shan, 3 km W Dali, 25°41'N, 100°07'E, 2750 m, 1.IX.2003, leg. Smetana (cSme, cAss); 1♀, Diancang Shan, 4 km W Dali, 25°41'N, 100°07'E, 2900–3000 m, 21.VIII.2003, leg. Smetana (cSme); 1♂, Diancang Shan, 3 km W Dali old Town, "cloud road", 25°41'N, 100°07'E, 2700 m, 17.VI.2005, leg. Smetana (cAss); 1♂, 5♀ [4 teneral], Diancang Shan, 3 km W Dali old Town, "cloud road", 25°41'N, 100°07'E, 2650–2750 m, pine forest, pine litter and moss in ditches sifted, 30.VIII.2003, leg. Schülke (cSch); 1♀ [teneral], same data, but 1.IX.2003, leg. Wrase (cSch); 1♀, same data, but 17.VI.2005, leg. Schülke (cAss); 1♀, same data, but 17.–23.VI.2005, leg Wrase (cSch); 3♂ [all slightly teneral], 1♀, Diancang Shan W Dali, 25°42'N, 100°07'E, 2860 m, pine forest, litter and moss sifted, 28.V.2007, leg. Pütz & Schülke (cPüt, cSch, cAss); 1♂, Diancang Shan, near Dali, 25°40'N, 100°08'E, 2730 m, 11.V.2010, leg. Grebennikov (cSme); 1♀, Diancang Shan, east slope of Zhonghe Shan, 25°41'N, 100°08'E, 2650 m, mixed forest with pine and rhododendron, litter sifted, 13.VI.2007, leg. Hájek & Růžička (cAss); 1♂, Diancang Shan, E pass 43 km NW Dali, 26°00'N, 100°00'E, 2700 m, secondary pine forest, litter and moss sifted, 23.VIII.2009, leg. Wrase (cAss); 1♂, 1♀, Diancang Shan above Dali, 2000–2200 m, 4–17.IV.1999, leg. Schawaller (SMNS, cAss); 2♂ [1 teneral], same data, but 2500–2700 m, 8–18.IV.1999 (SMNS, cAss); 1♀, same data, but 2700–2900 m, 14.IV.1999 (SMNS).

Comment. The original description of *N. daliensis* is based on numerous type specimens from the type locality ("Mt. Xiaojin Shan, Diancang Shan Mts., Dali Shi"), two other localities ("Zhonghe Feng", "Qinghi Xi") in the Diancang Shan, and from the "Laohu Shan, Dali Shi". Watanabe & Xiao (1997) illustrate the slightly different aedeagi of a male from the type locality and from the Laohu Shan. These illustrations are evidently not quite accurate, particularly regarding the shape of the dorso-lateral apophyses. Photographs of the head, the aedeagus, and of the male sternites VII and VIII are provided in Figs 61–64, 72–73. The above records are mapped in Fig. 88. Teneral specimens were collected in April and May, as well as in August and September.

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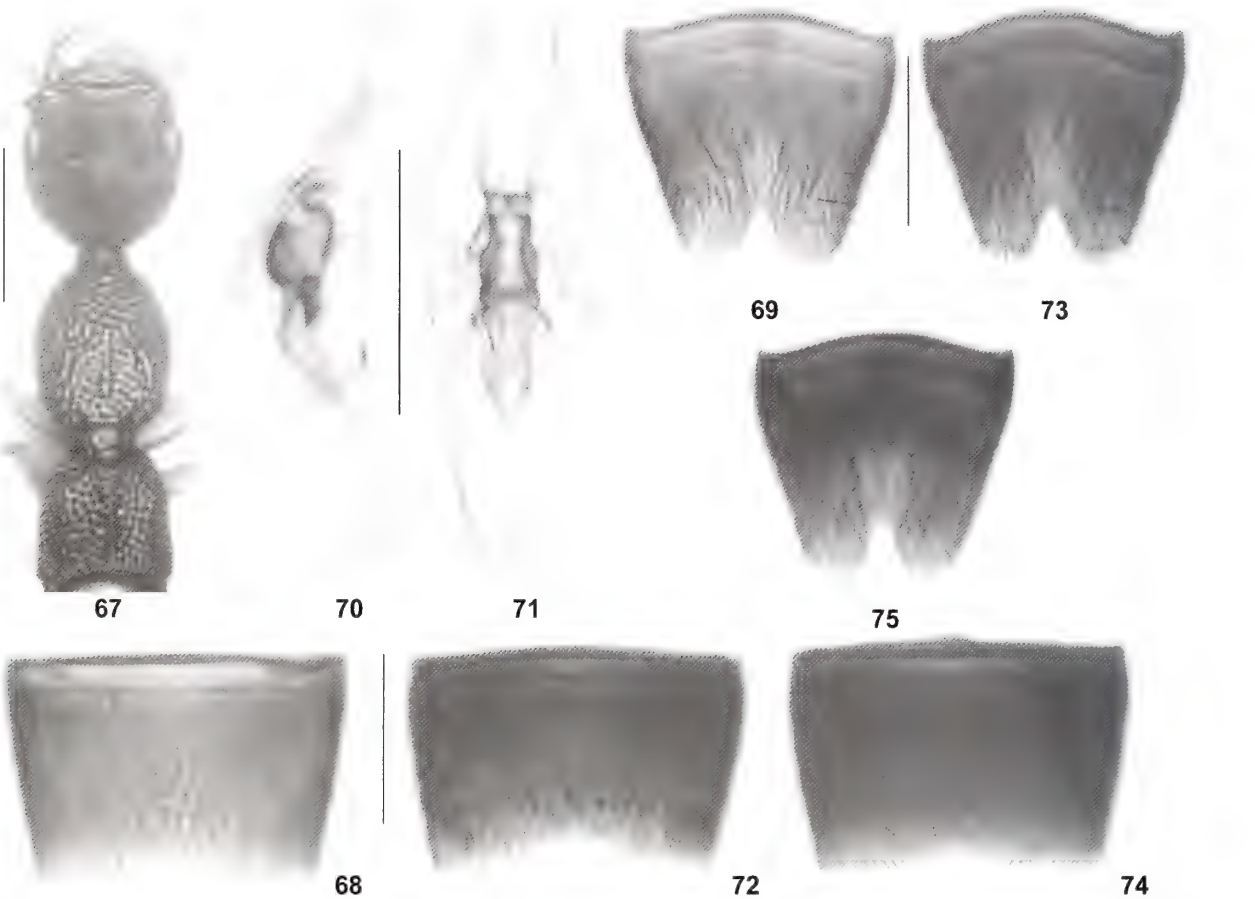

Figs 67–75. *Nazeris nivimontis* (**67–71**), *N. daliensis* (**72–73**), and *N. jizushanensis* (**74–75**). **67:** forebody; **68, 72, 74:** male sternite VII; **69, 73, 75:** male sternite VIII; **70–71:** aedeagus in lateral and in ventral view. Scale bars: 67: 1.0 mm; 68–75: 0.5 mm.

***Nazeris jizushanensis* Watanabe & Xiao, 1997** (Figs 65–66, 74–75, 88)

Material examined. China: Yunnan: 5♂, 5♀ [partly teneral], Dali Bai Aut. Pref., 37 km NE Dali, Jizu Shan, trail to cable car, 25°58'N, 100°23'E, 2450 m, mixed forest, litter an moss sifted, 5.IX.2009, leg. Schülke & Wrase (cSch, cAss); 2♂, 2♀, Jizu Shan, along trail to the summit, 25°58'N, 100°23'E, 2180–2580 m, mixed forest with pine, oak, and rhododendron, near stream, 22.–24.VI.2007, leg. Hájek & Růžička (cSch, cAss).

Comment. The original description is based on seven type specimens from the Jizu Shan (Watanabe & Xiao 1997), where the above specimens were collected, too (Fig. 88). The extremely similar external and male sexual characters suggest that *N. juzushanensis* is closely related to, and possibly the sister species of, *N. daliensis*, from which it is best distinguished by the differently shaped dorso-lateral apophyses of the larger aedeagus. The male sexual characters of *N. jizushanensis* are illustrated in Figs 65–66, 74–75.

***Nazeris wuliangicus* sp. n.** (Figs 54–60, 88)

Type material. Holotype ♂: "CHINA: Yunnan, Dali Bai Aut. Pref., Wuliang Shan, 9 km SW Weishan, 25°10'15.5"N, 100°14'21.8"E, 2480 m, scrub with (oak, alder, pine), litter & mushrooms sifted, 14.IX.2009, leg. M. Schülke [CH09-51] / Holotypus ♂ *Nazeris wuliangicus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 9♂, 7♀ [partly teneral]: same data as holotype (cSch, cAss); 6♂, 7♀: "CHINA: Yunnan [CH07-35], Dali Bai Auton. Pref., Wuliang Shan, 9 km SW Weishan, 2450-2500 m, 25°10'14"N, 100°14'22"E, oaks and pines, sifted, 13.VI.2007, M. Schülke" (cSch, cAss); 2♂, 6♀: same data, but leg. A. Pütz (cPüt, cAss); 3♂, 2♀: "CHINA (Yunnan) Dali Bai Auton. Pref., Wuliang Shan, 9 km SW Weishan, 2450–2500 m, 25°10'14"N, 100°14'22"E, (W. slope, sec. oak/pine for., pasture, und. stones),13.VI.2007 D.W. Wrase [35]" (cSch, cAss); 9♂, 20♀ [partly teneral]: "CHINA: Yunnan, Dali Bai Aut. Pref., mount. range E Wei-shan, 12 km NE Weishan, 25°17'02-15"N, 100°22'23-30"E, 2630–2660 m, scrub with pines and bamboo, litter sifted, 15.IX.2009, leg. M. Schülke [CH09-

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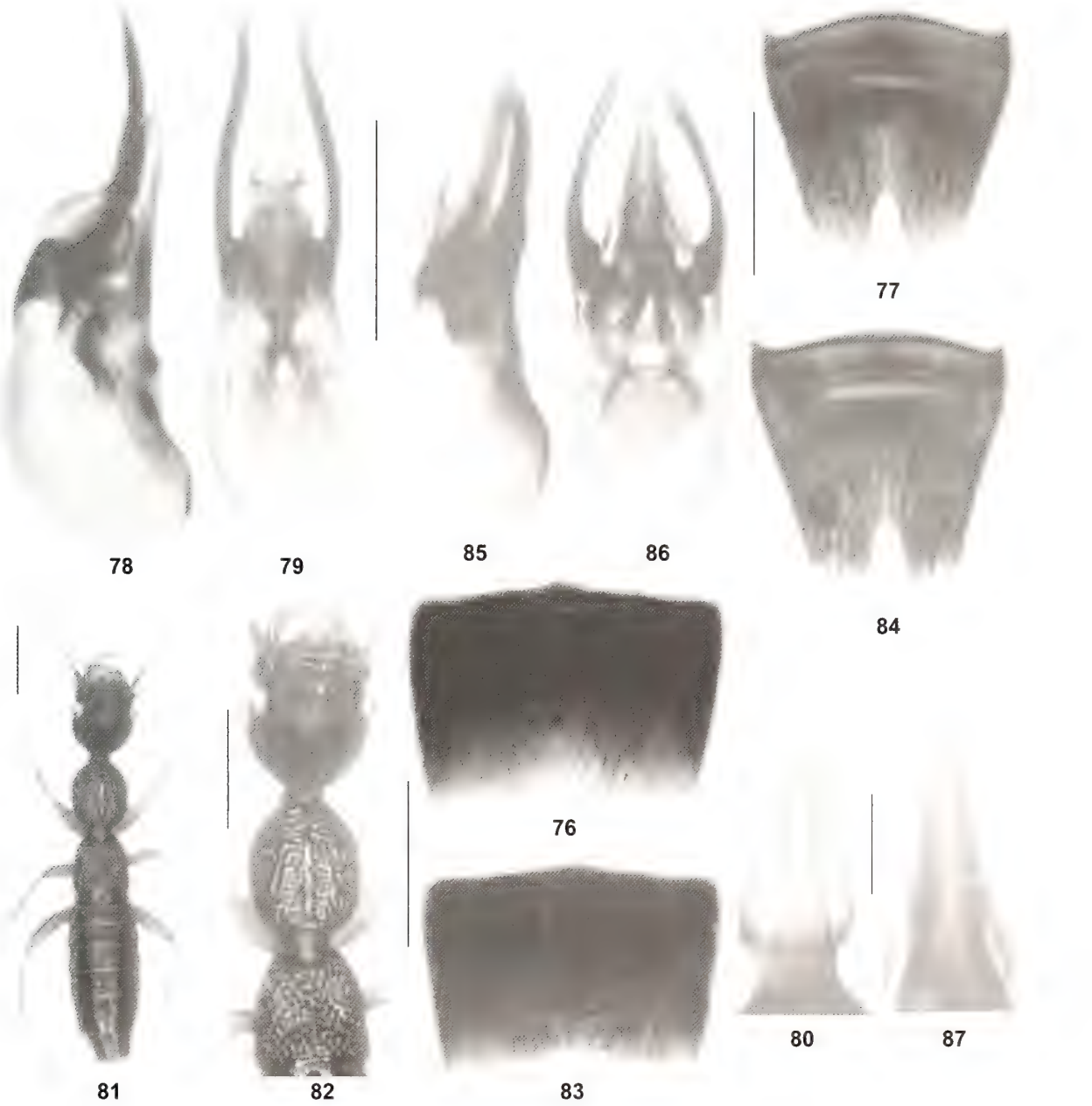

Figs 76–87. *Nazeris sagittifer* (**76–80**) and *N. secatus* (**81–87**). **76, 83:** male sternite VII; **77, 84:** male sternite VIII; **78–79, 85–86:** aedeagus in lateral and in ventral view; **80, 87:** ventral process of aedeagus in ventral view; **81:** habitus; **82:** forebody. Scale bars: 81–82: 1.0 mm; 76–79, 83–86: 0.5 mm; 80, 87: 0.1 mm.

54]" (ZFMK, cSch, cAss); 3♂ [1 teneral]: "CHINA (Yunnan) Dali Bai Aut. Pref., mount. range E Weishan, 12 km NE Weishan, 2630–2660 m (scrub with pines and bamboo, litter sifted) 25°17'02-15"N, 100°22'23-30"E, 15.IX.2009, D.W. Wrase [54A]" (cSch).

Etymology. The specific epithet is an adjective derived from the mountain range where the type locality is situated.

Description. Body length 5.2–6.3 mm; length of forebody 2.8–3.1 mm. Habitus as in Fig. 54. Coloration: body blackish-brown to black, with the elytra occasionally slightly paler; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 55) approximately 1.05 times as long as broad; median dorsal portion indistinctly elevated at most; punctation moderately coarse, dense, and umbilicate; interstices without microsculpture, forming narrow ridges;

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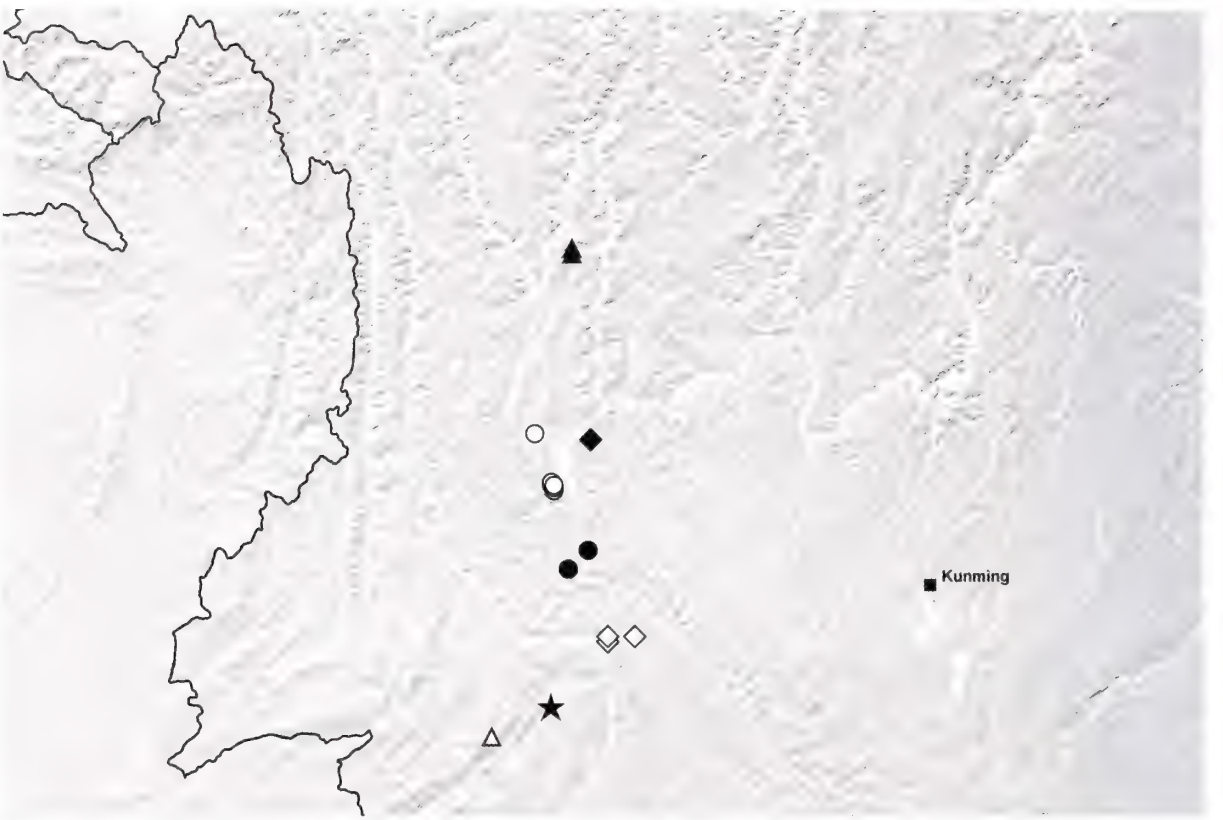

Fig. 88. Distributions of *Nazeris* species in Yunnan: *N. alpinus* (filled triangles); *N. daliensis* (open circles); *N. jizushanensis* (filled diamond); *N. wuliangicus* (filled circles); *N. sagittifer* (open diamonds); *N. nivimontis* (star); *N. secatus* (open triangle).

eyes moderately small, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 1.7 mm long.

Pronotum (Fig. 55) approximately 1.2 times as long as broad and 0.9 times as broad as head; punctation dense and non-umbilicate, much coarser than that of head; interstices glossy, forming narrow ridges; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 55) approximately 0.55 times as long as pronotum; humeral angles obsolete; punctation similar to that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.2 times as broad as elytra; punctation dense, defined, and coarse on tergites III–VI, much finer and sparser on tergites VII and VIII than on tergite VI; interstices without microsculpture and glossy; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII strongly convex.

♂: sternite VII (Fig. 56) with posterior margin very weakly concave in the middle, otherwise unmodified; sternite VIII (Fig. 57) weakly transverse, posterior excision small and V-shaped; aedeagus (Fig 58–60) approximately 0.85 mm long; ventral process short, apically acute in ventral view, and laterally somewhat compressed; dorsolateral apophyses long and slender, distinctly extending beyond apex of ventral process.

Comparative notes. Based on the shapes and chaetotaxy of the male sternite VII and VIII, as well as on the morphology of the aedeagus (short ventral process; long and slender dorso-lateral apophyses), *N. wuliangicus* is closely allied to *N. daliensis*, from which it differs particularly by the more slender dorso-lateral apophyses of the aedeagus. It is reliably distinguished from the geographically close *N. barbatus*, which too was found only in the Wuliang Shan, only by the completely different male sexual characters. The syntopic *N. fissus* is smaller and of more slender habitus, of paler coloration, has a more coarsely punctate head, a less densely punctate abdomen, and completely different male sexual characters.

Distribution and natural history. *Nazeris wuliangicus* was collected in two localities, one in the Wuliang Shan and the other in an adjacent mountain range to the east of Weishan, Yunnan (Fig. 88). The specimens were sifted from leaf litter in shrub habitats at altitudes of 2450–2660 m. Several specimens collected in September are teneral.

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***Nazeris nivimontis* sp. n.** (Figs 67–71, 88)

Type material. Holotype ♂ [teneral]: "CHINA: Yunnan, Lincang Pref., Xue Shan, 48 km N Lincang, 2070 m, 24°19'03"N, 100°07'13"E, forest remnant, N-slope, litter & mushrooms sifted, 12.IX.2009, leg. M. Schülke [CH09-45] / Holotypus ♂ *Nazeris nivimontis* sp. n. det. V. Assing 2013" (cAss). Paratype ♂: [teneral]: same data as holotype (cSch).

Etymology. The specific epithet is a noun composed of the Latin noun for snow (nix, nivis) and the genitive of the Latin noun for mountain (mons). It is derived from the name of the mountain (Xue Shan = Snow Mountain) where the species is probably endemic.

Description. Body length 5.6–5.9 mm; length of forebody 3.1–3.3 mm. Head (Fig. 67) 1.00–1.03 times as long as broad. Pronotum (Fig. 67) 0.85 times as broad as head. Other external characters as in *N. wuliangicus*.
♂: sternite VII (Fig. 68) with weakly concave posterior margin, otherwise unmodified; sternite VIII (Fig. 69) approximately 1.1 times as broad as long, posterior excision rather small and approximately V-shaped, but anteriorly rounded, not acute, nearly 0.2 times as deep as length of sternite; aedeagus (Figs 70–71) approximately 0.9 mm long; ventral process short, apically acute in ventral view; dorso-lateral apophyses moderately long and slender, distinctly extending beyond apex of ventral process.

Comparative notes. Based on the male primary and secondary sexual characters, *N. nivimontis* is undoubtedly closely related to *N. daliensis* and allied species. The shape of the ventral process of the aedeagus of *N. nivimontis* (ventral view) is remarkably similar to that of *N. wuliangicus*, from which *N. nivimontis* is distinguished by slightly larger body size, a larger head, the different shape of the posterior excision of the male sternite VIII, and by the relatively shorter dorso-lateral apophyses.

Distribution and natural history. The type locality is situated in the Xue Shan to the north of Lincang, Yunnan (Fig. 88). Both type specimens are teneral; they were sifted from forest leaf litter at an altitude of 2070 m.

***Nazeris sagittifer* sp. n.** (Figs 76–80, 88)

Type material. Holotype ♂: "CHINA: Yunnan, Pu'er Pref., Ailao Shan, 37 km NW Jingdong, 24°45'12"N, 100°41'24.5"E, 2300 m, devastated forest remnant, litter & dead wood sifted, 13.IX.2009, leg. M. Schülke [CH09-48] / Holotypus ♂ *Nazeris sagittifer* sp. n. det. V. Assing 2013" (cAss). Paratypes: 7♂, 3♀ [partly teneral]: same data as holotype (ZFMK, cSch, cAss); 3♀ [partly teneral]: "CHINA (Yunnan) Pu'er Pref., Ailao Shan, 37 km NW Jingdong, 24°45'12"N, 100°41'24.5"E, 2300 m (devastated forest remnant, litter, moss, grass roots sifted) 13.IX.2009 D.W. Wrase [48]" (cSch, cAss); 2♂: "CHINA: Yunnan, Lincang Pref., Wuliang Shan, old pass road, W side, 24°42'58.6"N, 100°29'52.0"E, 2200 m, small creek valley with primary forest remnant, litter sifted, 16.IX.2009, leg. M. Schülke [CH09-47a]" (cSch, cAss); 1♂, 2♀: same data, but "litter & debris sifted, ..., 12.X.2009 ... [CH09-47]" (cSch, cAss); 1♀: same data, as before, but leg D.W. Wrase (cSch); 2♂: "CHINA: Yunnan, Lincang/Dali Pref., Wuliang Shan, old pass road, N pass, 24°45'16.4"N, 100°29'50.3"E, 2350 m, forest litter & tea plantation, litter, mushrooms, grass sifted, 16.IX.2009, leg. M. Schülke [CH09-55]" (cSch, cAss).

Etymology. The specific epithet (Latin, adjective: carrying an arrow) alludes to the shape of the ventral process of the aedeagus, which in ventral view somewhat resembles an arrowhead.

Description. External characters as in *N. wuliangicus*.
♂: sternite VII (Fig. 76) with posterior margin distinctly concave in the middle, otherwise unmodified; sternite VIII (Fig. 77) approximately as long as broad, posterior excision narrowly V-shaped, its depth approximately 0.25 times the length of sternite; aedeagus (Figs 78–79) approximately 0.95 mm long; ventral process (Fig. 80) moderately short, apically acute, shaped like an arrowhead in ventral view, laterally somewhat compressed; dorso-lateral apophyses long and slender, distinctly extending beyond apex of ventral process.

Comparative notes. Based on the virtually identical external and the similar male sexual characters, *N. sagittifer* is closely related to the geographically close, apparently parapatric *N. wuliangicus*, from which it is reliably distinguished only by the male sexual characters, especially the more distinctly concave posterior margin of the male sternite VII, the deeper posterior excision of the male sternite VIII, and the longer aedeagus with a differently shaped ventral process and with longer dorso-lateral apophyses.

Distribution and natural history. *Nazeris sagittifer* is known from one locality in the Ailao Shan and two localities in the Wuliang Shan, Yunnan (Fig. 88). The specimens were sifted from forest leaf litter at altitudes of 2200–2350 m, on two occasions together with *N. fissus*. Some of the type specimens are teneral.

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Nazeris secatus **sp. n.** (Figs 81–88)

Type material. Holotype ♂: "CHINA: Yunnan, Lincang Pref., Laobie Shan, Wei Bo Shan pass, 24°08'16"N, 99°42'53"E, 2375 m, creek valley, devastated second. decid. forest, litter & moss sifted, 8.IX.2009, leg. M. Schülke [CH09-35] / Holotypus ♂ *Nazeris secatus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 3♂, 4♀ [3 teneral]: same data as holotype (cSch, cAss).

Etymology. The specific epithet is the past participle of the Latin verb secare (to cut off) and refers to the truncate lateral portions of the posterior margin of the male sternite VIII.

Description. Body length 5.2–5.8 mm; length of forebody 3.0–3.3 mm. Habitus as in Fig. 81. Coloration: body black; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 82) 1.01–1.04 times as long as broad; median dorsal portion elevated; punctation moderately coarse, dense, and umbilicate; interstices without microsculpture; eyes strongly convex and at least one third as long as the distance from posterior margin of eye to posterior constriction of head, usually somewhat longer. Antenna approximately 1.8 mm long.

Pronotum (Fig. 82) approximately 1.15 times as long as broad and 0.85–0.90 times as broad as head; punctation dense and non-umbilicate, much coarser than that of head; interstices glossy, forming narrow ridges; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 82) approximately 0.55 times as long as pronotum; humeral angles obsolete; punctation similar to that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.2 times as broad as elytra; punctation dense, defined, and coarse on tergites III–VI, somewhat finer and sparser on tergites VII and VIII; interstices without microsculpture and glossy; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII strongly convex.

♂: sternite VII (Fig. 83) with posterior margin weakly concave in the middle, otherwise not distinctly modified; sternite VIII (Fig. 84) approximately 1.05 times as broad as long, lateral portions of posterior margin obliquely truncate, posterior excision moderately deep and U-shaped, approximately 0.2 times as deep as length of sternite; aedeagus (Figs 85–86) 0.95–1.0 mm long; ventral process (Fig. 87) long and apically acute in ventral view, laterally compressed; dorso-lateral apophyses moderately long and weakly curved, slightly extending beyond apex of ventral process.

Comparative notes. The shapes of the male sternites VII and VIII are similar to those of the species allied to *N. daliensis*, but the ventral process of the aedeagus is much longer in relation to the dorso-lateral apophyses. *Nazeris secatus* is distinguished from the syntopic *N. lanuginosus* by slightly smaller body size, the relatively larger and more convex eyes, and the completely different male sexual characters (shape and chaetotaxy of the male sternite VII; sternite VIII with less deep posterior excision and with obliquely truncate lateral portions of the posterior margin; ventral process of the aedeagus less slender in ventral view; dorso-lateral apophyses more slender, less strongly sclerotized, and shorter in relation to ventral process).

Distribution and natural history. The type locality is situated in the Laobie Shan (Fig. 88). The partly teneral type specimens were sifted from litter in a secondary deciduous forest at an altitude of 2375 m, together with *N. lanuginosus*.

Nazeris cangicus **sp. n.** (Figs 89, 91–97)

Type material. Holotype ♂: "CHINA: N-Yunnan [C03-19], Dali Bai Nat. Aut. Pref., Diancang Shan, 3 km W Dali old town, creek valley and pine forest at "Cloud Road", right upper chairlift station, 25°41.1'N, 100°06.8'E, 2650–2750 m / [C03-19] litter, pine needles, moss (dry and wet), mushrooms, 29.VIII.2003, leg. M. Schülke / Holotypus ♂ *Nazeris cangicus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 1♂, 1♀: same data as holotype (cSch); 1♂: "CHINA: N-Yunnan Dali Bai Aut. Pref. Diancang Shan 3 km W Dali, 25°41.1'N, 100°06.8'E, 2650–2750 m / 29.8.03, A. Smetana [C140]" (cAss); 3♂: "CHINA: N-Yunnan [C03-20], Dali Bai Nat. Aut. Pref., Diancang Shan, 4 km W Dali old town, 25°41.4'N, 100°06.7'E, 2900–3000 m, E-slope with devastated forest and old pine forest, mushrooms, 31.VIII.2003, leg. M. Schülke" (cSch, cAss); 1♀ [teneral]: "CHINA (N-Yunnan) Dali Bai Nat. Aut. Pref., Diancang Shan, 4 km W Dali old town, 2900–3000 m, 25°41.4'N, 100°06.7'E, E-slope, (edge of road, slope with Salix, bamboo, knotgrass, leaf litter, sifted), 22.VI.2005 D.W. Wrase [15]" (cSch); 2♂, 1♀: "CHINA: Yunnan [CH07-03], Dali Bai Auton. Pref., Diancang Shan W Dali, 25°41'49"N, 100°06'24"E, 2970 m, sifted at rock edges and under shrubs, 28.V.2007, M. Schülke" (cSch, cAss); 1♂, 3♀: "CHINA: Yunnan [CH07-04], Dali Bai Auton. Pref., Diancang Shan W Dali, 25°41'47"N, 100°06'32"E, 3016 m, moist escarpment, litter sifted, 28.V.2007, M. Schülke" (cSch, cAss); 1♂: "CHINA: Yunnan, Dali Bai Aut. Pref., Diacang [sic] Shan, W Dali, 25°41'52"N, 100°06'28"E, 2960 m, along path, sifted from litter, moss, flood debris, 6.IX.2009, leg. M. Schülke [CH09-31]" (cAss); 1♂, 1♀: "CHINA (Yunnan)

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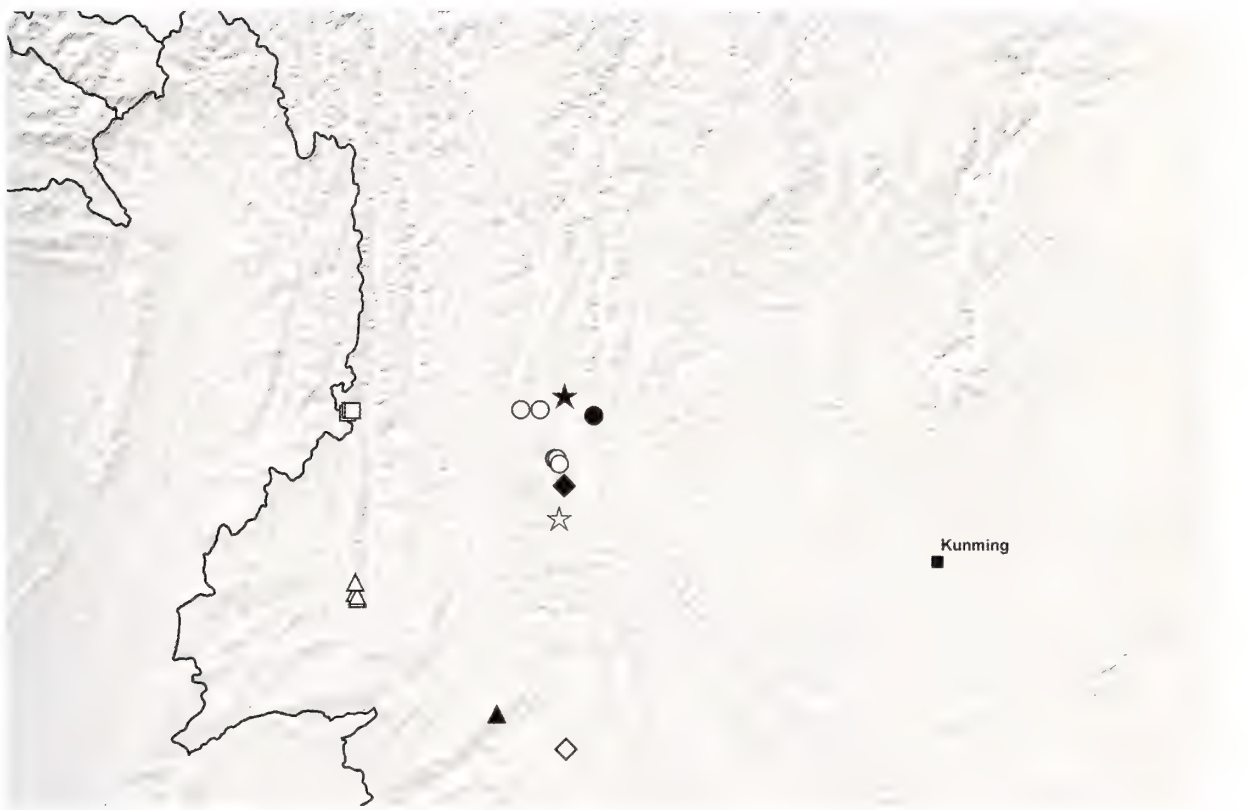

Fig. 89. Distributions of *Nazeris* species in Yunnan: *N. cangicus* (open circles); *N. aculeatus* (filled circle); *N. zhemoicus* (filled diamond); *N. pungens* (open diamond); *N. lanuginosus* (filled triangle); *N. peniculatus* (filled star); *N. barbatus* (open star); *N. curvus* (open triangles); *N. subdentatus* (open squares).

Dali Bai Aut. Pref., Diancang Shan E pass, 43 km NW Dali, 2700 m, (secondary pine forest, litter, moss sifted), 25°59'50"N, 100°00'30"E, 23.VIII.2009 D.W. Wrase [02]" (cSch, cAss); 1♀: "CHINA: Yunnan, Dali Bai Aut. Pref., Diancang Shan, E pass, 43 km NW Dali, 25°59'50"N, 100°00'30"E, 2700 m, secondary pine forest, litter, moss and mushrooms sifted, 23.VIII.2009, leg. M. Schülke [CH09-02]" (ZFMK); 1♂, 2♀: "CHINA (Yunnan) Dali Bai Aut. Pref., Diancang Shan E pass, 43 km NW Dali, 3104 m, (oak shrubs, Rhod., bamboo, litter sifted), 25°59'33.5"N, 99°52'12.5"E, 23.VIII.2009 D.W. Wrase [01A]" (cSch, cAss); 2♂, 3♀ [partly slightly teneral]: "CHINA: Yunnan [CH07-08], Dali Bai Auton. Pref., Diancang Shan 43 km NW Dali, 3078 m, 25°59'35"N, 99°52'06"E, W pass, Rhodod., oaks, bamboo, sifted, 29.V.2007, M. Schülke" (cSch, cAss); 3♂: "P.R. CHINA, Yunnan, E slope Cangshan at Dali, N25°40'15.5", E100°07'45.4", 18.v.2010, 2657 m, sifting17, V.Grebennikov" (CAS, cAss); 1♂, 4♀: "P.R. CHINA, Yunnan, E slope Cangshan at Dali, N25°40'13.2", E100°07'54.8", 11.v.2010, 2728 m, sifting05, V.Grebennikov" (CAS, cSme); 1♀: "P.R. CHINA, Yunnan, E slope Cangshan at Dali, N25°40'15.1", E100°07'39.9", 10.v.2010, 2711 m, sifting04, V.Grebennikov" (CAS); 1♀: "P.R. CHINA, Yunnan, E slope Cangshan at Dali, N25°40'13.2", E100°07'54.8", 13.v.2010, 2728 m, sifting08, V.Grebennikov" (CAS); 1♂: "P.R. CHINA, Yunnan, E slope Cangshan at Dali, N25°40'13.2", E100°07'54.8", 9.v.2010, 2728 m, sifting01, V.Grebennikov" (cAss); 1♀: "CHINA: Yunnan [CH07-04], Dali Bai Auton. Pref., Diancang Shan W Dali, 25°41'47"N, 100°06'32"E, 3016 m, moist escarpment, litter sifted, 28.V.2007, leg. A. Pütz" (cPüt); 1♂, 2♀: "CHINA: Yunnan, above Dali, 2500–2700 m, 9.–18.IV.1999, leg. W. Schawaller" (SMNS, cAss).

Etymology. The specific epithet is an adjective derived from Cang (= Diancang) Shan, the name of the mountain range where the species was discovered.

Description. Body length 6.0–7.0 mm; length of forebody 3.1–3.5 mm. Habitus as in Fig. 91. Coloration: body blackish; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 92) 1.05–1.10 times as long as broad; median dorsal portion more or less distinctly elevated, i.e., above the level of the frons; punctation coarse, dense, and umbilicate (Fig. 93); interstices without microsculpture; eyes moderately small, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna 1.7–1.9 mm long.

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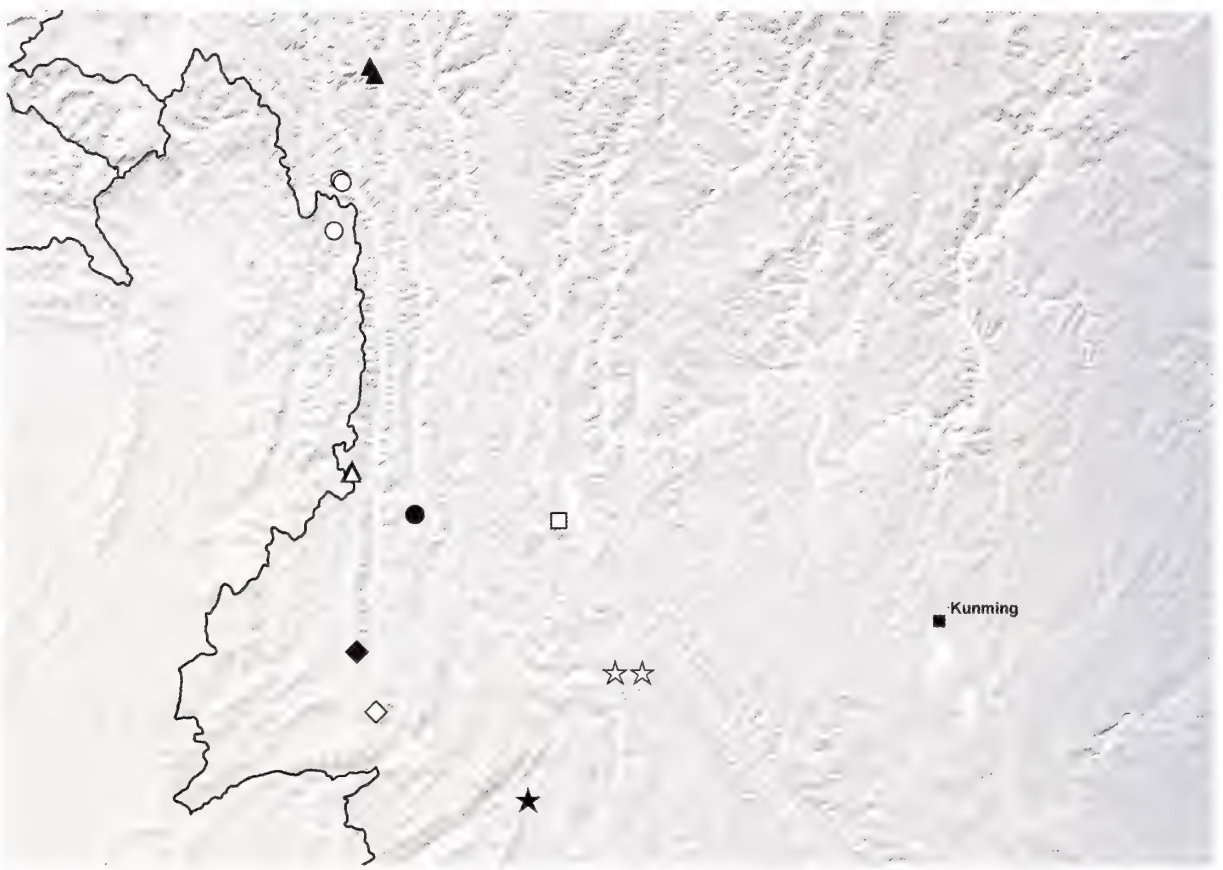

Fig. 90. Distributions of *Nazeris* species in Yunnan: *N. firmilobatus* (open circles); *N. spiculatus* (open diamond); *N. infractus* (filled circle); *N. meilicus* (filled triangles); *N. vexillatus* and *N. hastatus* (open triangles); *N. circumclusus* (filled diamond); *N. bangmaicus* (filled star); *N. fissus* (open stars); *N. giganteus* (open square).

Pronotum (Fig. 92) approximately 1.15 times as long as broad and 0.9 times as broad as head; punctation approximately as coarse as that of head, non-umbilicate, and moderately dense; interstices narrower than diameter of punctures, glossy; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 92) 0.60–0.65 times as long as pronotum; humeral angles obsolete; punctation dense, moderately defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.25 times as broad as elytra; punctation dense, defined, and moderately coarse on anterior tergites, gradually becoming less dense and finer towards posterior tergites, sparse and fine on tergite VII, even finer and sparser on tergite VIII; interstices without microsculpture on tergites III–VI, with very shallow microreticulation on tergites VII–VIII; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII weakly convex.

♂: sternite VII (Fig. 94) with posterior margin distinctly concave in the middle; sternite VIII (Fig. 95) approximately as long as broad, posterior excision deep and narrow, approximately 0.35 times as deep as length of sternite; aedeagus (Figs 96–97) 0.9–1.0 mm long; ventral process apically very acute in ventral view, laterally compressed; dorso-lateral apophyses rather short, slightly extending beyond apex of ventral process.

Comparative notes. *Nazeris cangicus* is distinguished from the syntopic *N. daliensis*, a species of similar size, by the coarser, deeper, and less dense punctation of the head, by the more or less distinctly elevated median portion of the head, by the shapes of the male sternites VII and VIII, as well as by the morphology of the aedeagus, particularly the much shorter dorso-lateral apophyses. For illustrations of the head and the male sexual characters of *N. daliensis* see Figs 61–64.

Together with several other species recorded from Yunnan, *N. cangicus* forms a group characterized by more or less blackish body colour, a male sternite VII mostly with a distinct posterior concavity and/or a postero-median impression, a male sternite VIII often with a median impression and a rather deep and narrow posterior excision, and an aedeagus with a slender, laterally more or less compressed, and apically acute ventral process and with short to moderately long dorso-lateral apophyses.

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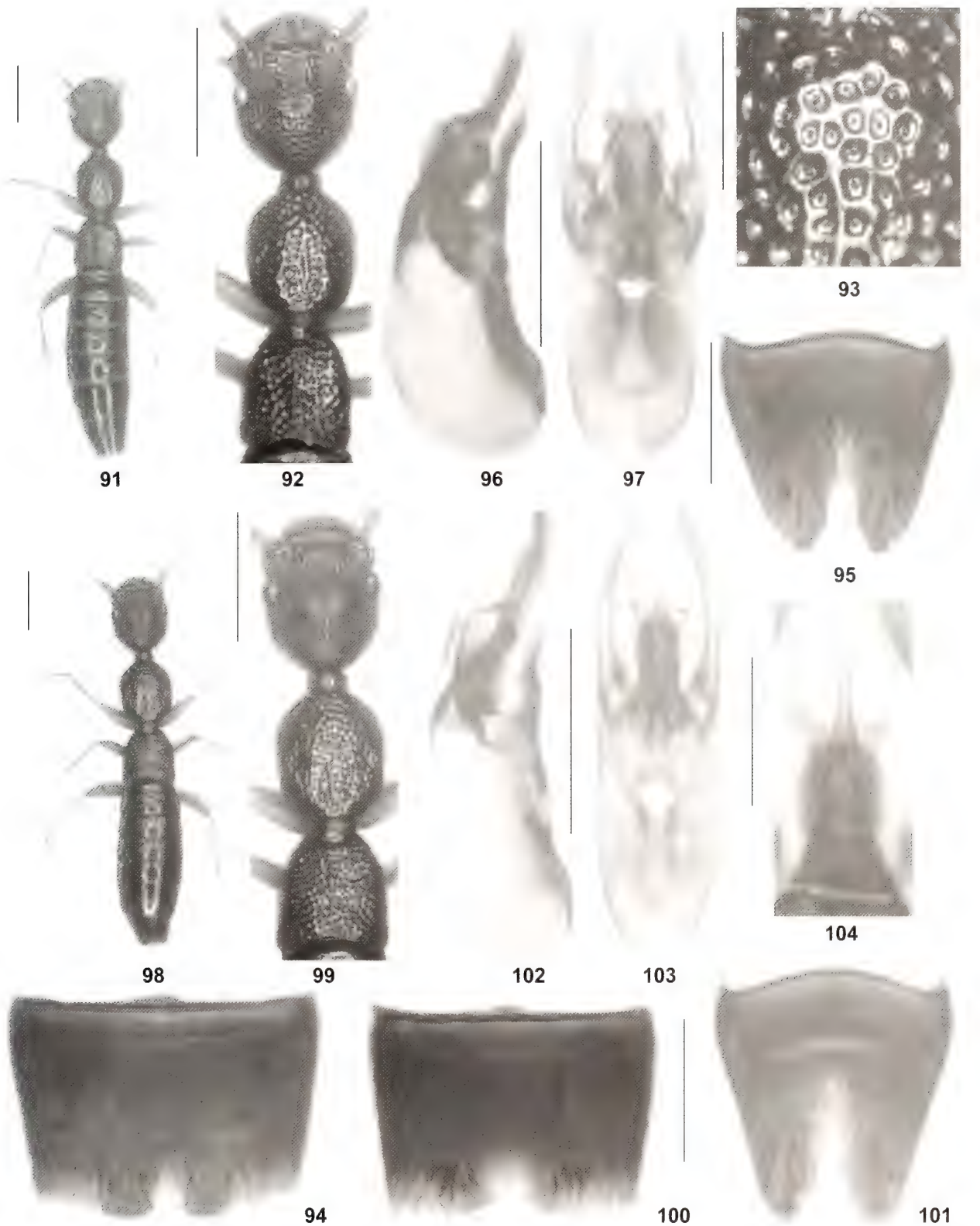

Figs 91–104. *Nazeris cangicus* (**91–97**) and *N. aculeatus* (**98–104**). **91, 98:** habitus; **92, 99:** forebody; **93:** median dorsal portion of head; **94, 100:** male sternite VII; **95, 101:** male sternite VIII; **96–97, 102–103:** aedeagus in lateral and in ventral view; **104:** ventral process of aedeagus in ventral view. Scale bars: 91–92, 98–99: 1.0 mm; 94–97, 100–103: 0.5 mm, 93, 104: 0.2 mm.

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Distribution and natural history. The type specimens were discovered in several localities in the Diancang Shan (Fig. 89). They were sifted from litter and moss in various kinds of forests and shrub habitats at altitudes of 2650–3100 m, partly together with *N. daliensis*.

Nazeris aculeatus sp. n. (Figs 89, 98–104)

Type material. Holotype ♂: "CHINA: Yunnan, Dali Bai Aut. Pref., Jizu Shan, summit plateau, 37 km NE Dali, 25°58'30"N, 100°21'36"E, 3150 m, mixed forest, sifted from litter, moss & mushrooms, 5.IX.2009, leg. M. Schülke [CH09-28] / Holotypus ♂ *Nazeris aculeatus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 1♀: same data as holotype (cSch); 3♂, 1♀: "CHINA (Yunnan) Dali Bai Aut. Pref., Jizu Shan, summit plateau, 37 km NE Dali 3150 m, (mixed forest, sifted from litter, moss), 25°58'30"N, 100°21'36"E, 5.IX.2009 D.W. Wrase [28]" (cSch, cAss).

Etymology. The specific epithet (Latin, adjective: with sting) alludes to the very slender and apically acute ventral process of the aedeagus in ventral view.

Description. Body length 5.8–6.8 mm; length of forebody 3.1–3.4 mm. Habitus as in Fig. 98. Coloration: body blackish-brown to blackish; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 99) 1.05–1.10 times as long as broad; median dorsal portion weakly elevated; punctation moderately coarse, dense, and umbilicate; interstices without microsculpture; eyes moderately small, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 1.8 mm long.

Pronotum (Fig. 99) approximately 1.15–1.20 times as long as broad and 0.9 times as broad as head; punctation approximately as coarse as that of head, non-umbilicate, and dense; interstices distinctly narrower than diameter of punctures, glossy; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 99) approximately 0.6 times as long as pronotum; humeral angles obsolete; punctation dense, moderately defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen 1.2 times as broad as elytra; punctation dense, defined, and moderately coarse on anterior tergites, gradually becoming less dense and finer towards posterior tergites, sparse and fine on tergite VII, even finer and sparser on tergite VIII; interstices without microsculpture on tergites III–VI, with very shallow microreticulation on tergites VII–VIII; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII convex.

♂: posterior margin of sternite VII with broadly V-shaped median excision (Fig. 100); sternite VIII (Fig. 101) approximately as long as broad, posterior excision deep and narrow, approximately 0.35 times as deep as length of sternite; aedeagus (Figs 102–104) approximately 1.0 mm long; ventral process narrow and apically very acute in ventral view, laterally compressed in dry preparation, lateral parts somewhat dilated in ventral view (in microscopic preparation); dorso-lateral apophyses of moderate length, slightly extending beyond apex of ventral process.

Comparative notes. Based on the similar external and particularly the similar male sexual characters, *Nazeris aculeatus* is closely related to, and probably the adelphotaxon of, *N. cangicus*, from which it differs by the less coarse and slightly denser punctation of the forebody, the shape of the posterior excision of the male sternite VII, and by the morphology of the aedeagus (ventral face of the ventral process basally more slender, lateral parts of ventral process of different shape). It is distinguished from the sympatric *N. jizushanensis* by the slightly more coarsely punctate and less matt head, the less densely and less coarsely punctate pronotum, the less coarsely and less densely punctate abdomen, the presence of shallow microsculpture on tergites VII and VIII (absent in *N. jizushanensis*), the completely different shapes of the male sternites VII and VIII, and by the different morphology of the aedeagus (shape of venrtral process both in ventral and in lateral view; dorso-lateral apophyses much shorter in relation to ventral process).

Distribution and natural history. The type locality is situated nearly 40 km to the northeast of Dali, on the summit of the Jizu Shan (Fig. 89) at an altitude of 3150 m. The specimens were sifted from litter and moss in a mixed forest.

Nazeris zhemoicus sp. n. (Figs 89, 105–110)

Type material. Holotype ♂ [teneral]: "CHINA: Yunnan, Dali Bai Aut. Pref., Zhemo Shan, 7 km SW Xiaguan, 25°32-33'N, 100°10-11'E, 2870–2970 m, scrub with bamboo, oaks & Rhododendr., litter sifted, 18.IX.2009, leg. M. Schülke [CH09-60] / Holotypus ♂ *Nazeris zhemoicus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 2♀: same data as holotype (cSch, cAss).

Etymology. The specific epithet is an adjective derived from the name of the mountain where the species is probably endemic.

Description. Body length 5.4–5.7 mm; length of forebody 3.0–3.1 mm. Habitus as in Fig. 105. External characters (Fig. 106) as in *N. cangicus*.

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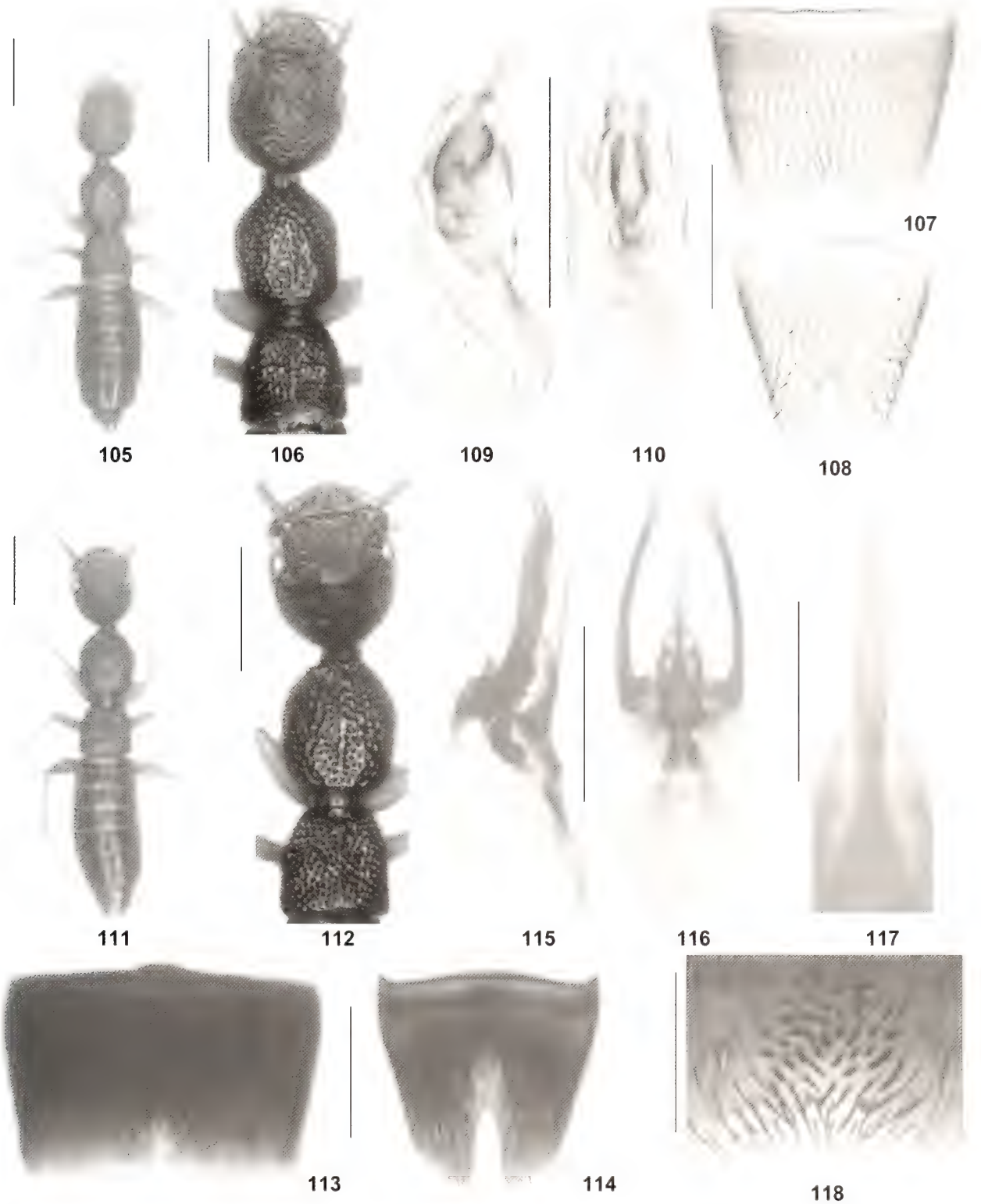

Figs 105–118. *Nazeris zhemoicus* **(105–110)**, *N. pungens* **(111–117)**, and *N. peniculatus* **(118)**. **105, 111:** habitus; **106, 112:** forebody; **107, 113:** male sternite VII; **108, 114:** male sternite VIII; **109–110, 115–116:** aedeagus in lateral and in ventral view; **117:** ventral process of aedeagus in ventral view; **118:** postero-median portion of male sternite VII. Scale bars: 105–106, 111–112: 1.0 mm; 107–110, 113–116: 0.5 mm, 117–118: 0.2 mm.

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♂: sternite VII (Fig. 107) with small postero-median impression, posterior margin with distinct excision in the middle; sternite VIII (Fig. 108) approximately as long as broad and with oblong median impression, posterior excision deep and rather narrow, approximately one third as deep as length of sternite; aedeagus (Figs 109–110) approximately 0.9 mm long; ventral process short, laterally somewhat compressed; dorso-lateral apophyses simple, distinctly extending beyond apex of ventral process.

Comparative notes. As can be inferred from the highly similar external and particularly the male sexual characters (sternite VII with posterior impression and medially excised posterior margin; sternite VIII with deep and narrow posterior excision; morphology of the aedeagus), *N. zhemoicus* is closely related to *N. cangicus*, from which it differs by the smaller aedeagus with a differently shaped ventral process and with the dorso-lateral apophyses longer in relation to the ventral process.

Distribution and natural history. The type locality is situated in the Zhemo Shan to the southwest of Xiaguan in Yunnan (Fig. 89). The specimens were sifted from leaf litter in a shrub habitat with oak, bamboo, and rhododendron at an altitude of 2870–2970 m, together with two females of a presumably undescribed species. The holotype is distinctly teneral.

Nazeris pungens sp. n. (Figs 89, 111–117)

Type material. Holotype ♂: "CHINA: Yunnan, Lincang Pref., Xue Shan, 11 km ENE Lincang, 2510 m, 23°55'01"N, 100°11'17.5"E, second. pine forest with Rhodod., small cleft with water, litter & mushrooms sifted, 10.IX.2009, leg. M. Schülke [CH09-39] / Holotypus ♂ *Nazeris pungens* sp. n. det. V. Assing 2013" (cAss). Paratypes: 21♂, 17♀ [partly teneral]: same data as holotype (cSch, cAss); 5♂, 4♀ [partly teneral]: "CHINA (Yunnan) Lincang Pref., Xue Shan, 11 km ENE Lincang, 2510 m, 23°55'01"N, 100°11'17.5"E (second. pine forest with Rhodod., small cleft with water, litter sifted) 10.IX.2009 D.W. Wrase [39]" (ZFMK, cSch, cAss).

Etymology. The specific epithet is the present participle of the Latin verb pungere (to sting) and refers to the sting-shaped (ventral view) ventral process of the aedeagus.

Description. Body length 5.5–6.5 mm; length of forebody 3.2–3.6 mm. Habitus as in Fig. 111. Coloration: body black; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 112) 1.03–1.09 times as long as broad; median dorsal portion weakly elevated; punctation moderately coarse, dense, and umbilicate; interstices without microsculpture; eyes moderately small, less than one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna 1.9–2.0 mm long.

Pronotum (Fig. 112) 1.15–1.20 times as long as broad and approximately 0.9 times as broad as head; punctation dense and non-umbilicate, distinctly coarser than that of head; interstices glossy, forming narrow ridges; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 112) approximately 0.55 times as long as pronotum; humeral angles obsolete; punctation similar to that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen 1.20–1.25 times as broad as elytra; punctation dense, defined, and coarse on tergites III–VI, finer and sparser on tergites VII and VIII; interstices without microsculpture and glossy; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII strongly convex.

♂: sternite VII (Fig. 113) with small and shallow postero-median impression, this impression with a cluster of rather sparse black setae directed postero-mediad, posterior margin weakly concave in the middle; sternite VIII (Fig. 114) approximately 1.1 times as broad as long, posterior excision deep and narrow, approximately 0.35 times as deep as length of sternite; aedeagus (Figs 115–117) approximately 1.05 mm long; ventral process long, conspicuously narrow and apically very acute in ventral view, laterally compressed; dorso-lateral apophyses long and slender, subapically bent and with lamellate dilatation, distinctly extending beyond apex of ventral process.

Comparative notes. The shape and chaetotaxy of the male sternite VII and the deep, narrow posterior excision of the male sternite VIII suggest that *N. pungens* belongs to the group of species allied to *N. cangicus*. Unlike the above species of this group, the dorso-lateral apophyses of the aedeagus are much longer and more slender.

Distribution and natural history. The type locality is situated in the Xue Shan to the east-northeast of Lincang (Fig. 89). The partly teneral type specimens were sifted from litter in a secondary pine forest with rhododendron at an altitude of 2510 m.

Nazeris lanuginosus sp. n. (Figs 89, 118, 119–123)

Type material. Holotype ♂: "CHINA: Yunnan, Lincang Pref., Laobie Shan, Wei Bo Shan pass, 24°08'16"N, 99°42'53"E, 2375 m, creek valley, devastated second. decid. forest, litter & moss sifted, 8.IX.2009, leg. M. Schülke [CH09-35] / Holotypus ♂ *Nazeris lanuginosus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 3♀ [1 teneral]: same data as holotype (cSch).

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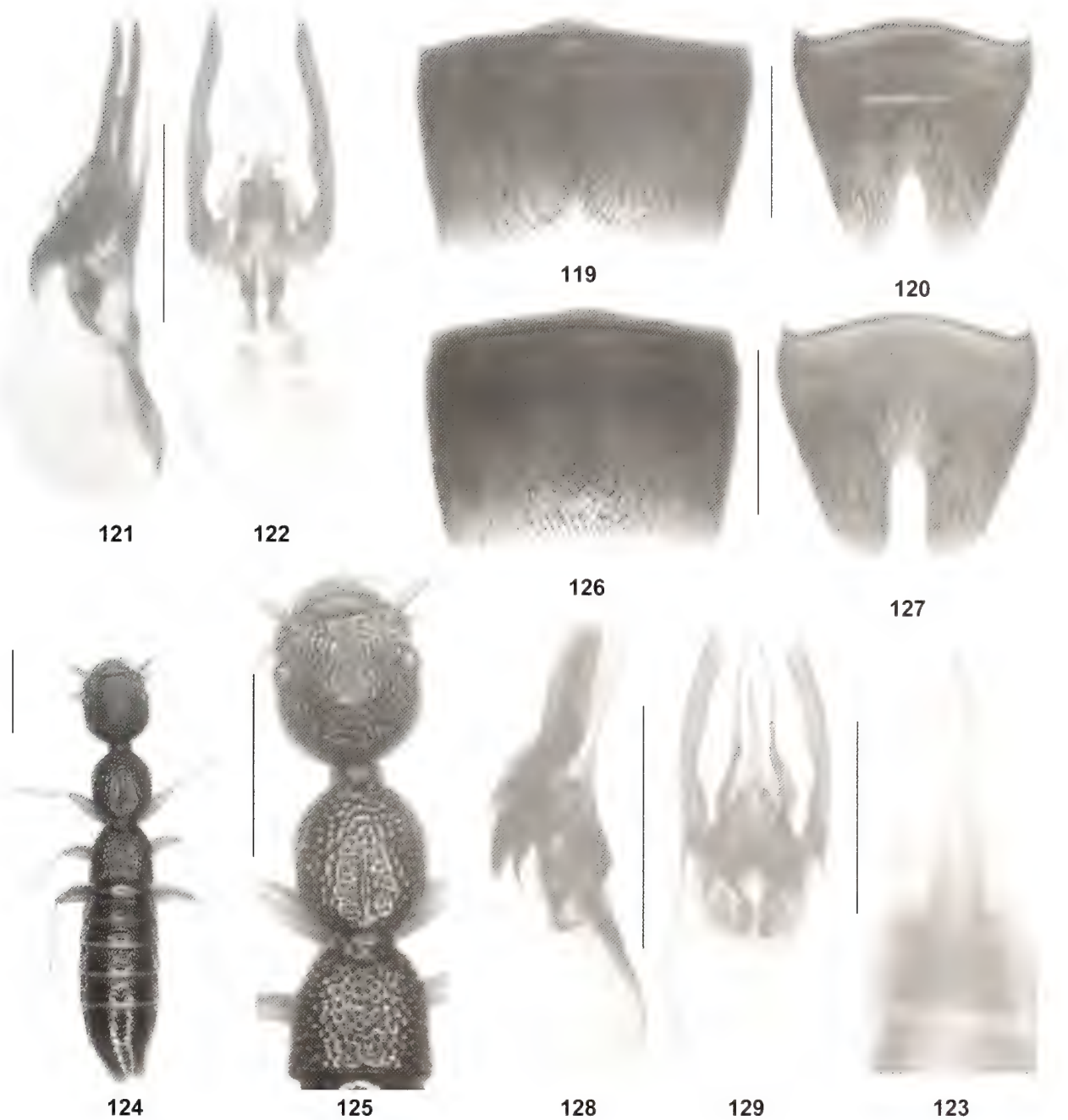

Figs 119–129. *Nazeris lanuginosus* (**119–123**) and *N. peniculatus* (**124–129**). **119, 126:** male sternite VII; **120, 127:** male sternite VIII; **121–122, 128–129:** aedeagus in lateral and in ventral view; **123:** ventral process of aedeagus in ventral view; **124:** habitus; **125:** forebody. Scale bars: 124–125: 1.0 mm; 119–122, 126–129: 0.5 mm, 123: 0.2 mm.

Etymology. The specific epithet is an adjective derived from the Latin noun lanugo (downy beard, downy pubescence) and alludes to the postero-median cluster of setae on the male sternite VII.

Description. Body length 5.8–6.2 mm; length of forebody 3.4–3.5 mm. Head weakly oblong, 1.01–1.06 times as long as broad. Other external characters as in *N. pungens*.

♂: sternite VII (Fig. 119) with postero-median impression, this impression with a cluster of dense black setae

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directed postero-mediad, posterior margin distinctly concave in the middle; sternite VIII (Fig. 120) 1.05 times as broad as long, posterior excision deep and narrow, 0.34 times as deep as length of sternite; aedeagus (Figs 121–123) 1.05 mm long; ventral process long, narrow and apically very acute in ventral view, laterally compressed; dorso-lateral apophyses moderately long, stout, strongly sclerotized, slightly dilated at basal third, and distinctly extending beyond apex of ventral process.

Comparative notes. Based on the shapes and chaetotaxy of the male sternites VII and VIII, as well as on the morphology of the aedeagus, *N. lanuginosus* is most closely related to *N. pungens*, from which it differs by the less oblong head, the denser postero-median cluster of black setae and the pronounced posterior concavity of the male sternite VII, and by the morphology of the aedeagus (shapes of the ventral process and of the dorso-lateral apophyses).

Distribution and natural history. The type locality is situated in the Laobie Shan (Fig. 89). The partly teneral type specimens were sifted from litter in a secondary deciduous forest at an altitude of 2375 m, together with *N. secatus*.

***Nazeris peniculatus* sp. n.** (Fig. 89, 118, 124–129)

Type material. Holotype ♂: "CHINA: Yunnan [CH07-31], Dali Bai Auton. Pref., mtn. range N Er Hai, 42 km N Dali, 26°04'53"N, 100°09'39"E, 2500–2550 m, NE slope with oaks, litter sifted, 12.VI.2007, M. Schülke / Holotypus ♂ *Nazeris peniculatus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 10♂, 11♀: same data as holotype (ZFMK, cSch, cAss).

Etymology. The specific epithet is an adjective derived from the Latin noun peniculus (brush) and refers to the conspicuous cluster of modified setae on the male sternite VII.

Description. Small species; body length 4.7–5.7 mm; length of forebody 2.5–2.9 mm. Habitus as in Fig. 124. Coloration: body black; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 125) as long as broad or weakly oblong; median dorsal portion weakly elevated; punctation moderately coarse, dense, and umbilicate; interstices without microsculpture; eyes moderately small, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 1.5 mm long.

Pronotum (Fig. 125) approximately 1.15 times as long as broad and 0.9 times as broad as head; punctures dense and non-umbilicate, of similar diameter as those of head, but distinctly deeper; interstices glossy, forming narrow ridges; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 125) approximately 0.6 times as long as pronotum; humeral angles obsolete; punctation similar to that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.2 times as broad as elytra; punctation dense, defined, and coarse on tergites III–VI, much finer and sparser on tergites VII and VIII than on tergite VI; interstices without microsculpture and glossy; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII strongly convex.

♂: sternite VII (Fig. 126) with postero-median impression, this impression with a conspicuous cluster of distinctly modified short and stout black setae (Fig. 118), posteriorly with dense long black setae, posterior margin distinctly concave in the middle; sternite VIII (Fig. 127) weakly transverse, posterior excision very deep and narrowly U-shaped, approximately 0.4 times as deep as length of sternite; aedeagus (Figs 128–129) approximately 0.95 mm long; ventral process long, narrow and apically very acute in ventral view; dorso-lateral apophyses slender, somewhat sinuate at basal 2/5, apically obliquely truncate, and not reaching apex of ventral process.

Comparative notes. Based on the external (punctation of the forebody) and the male sexual characters (sternite VII with postero-median impression and with concave posterior margin; sternite VIII with deep and narrow posterior excision; ventral process of aedeagus slender, apically acute, and extending beyond the apices of the dorso-lateral apophyses), *N. peniculatus* belongs to the group of species allied to *N. cangicus*. It is distinguished from them particularly by the deeper posterior excision of the male sternite VIII, the morphology of the aedeagus, and (except for *N. barbatus*) by the conspicuous chaetotaxy of the male sternite VII.

Distribution and natural history. The type locality is situated in a mountain range to the north of the Er Hai lake (Fig. 89). The specimens were sifted from oak leaf litter at an altitude of 2500–2550 m.

***Nazeris barbatus* sp. n.** (Figs 89, 130–136)

Type material. Holotype ♂: "CHINA: Yunnan, Dali Bai Aut. Pref., Wuliang Shan, 20 km NW Weishan, 25°19'58"N, 100°07'59"E, 1900 m, creek valley, litter & old flood debris sifted, 17.IX.2009, leg. M. Schülke [CH09-58] / Holotypus ♂ *Nazeris barbatus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 1♂, 1♀: same data as holotype (cSch).

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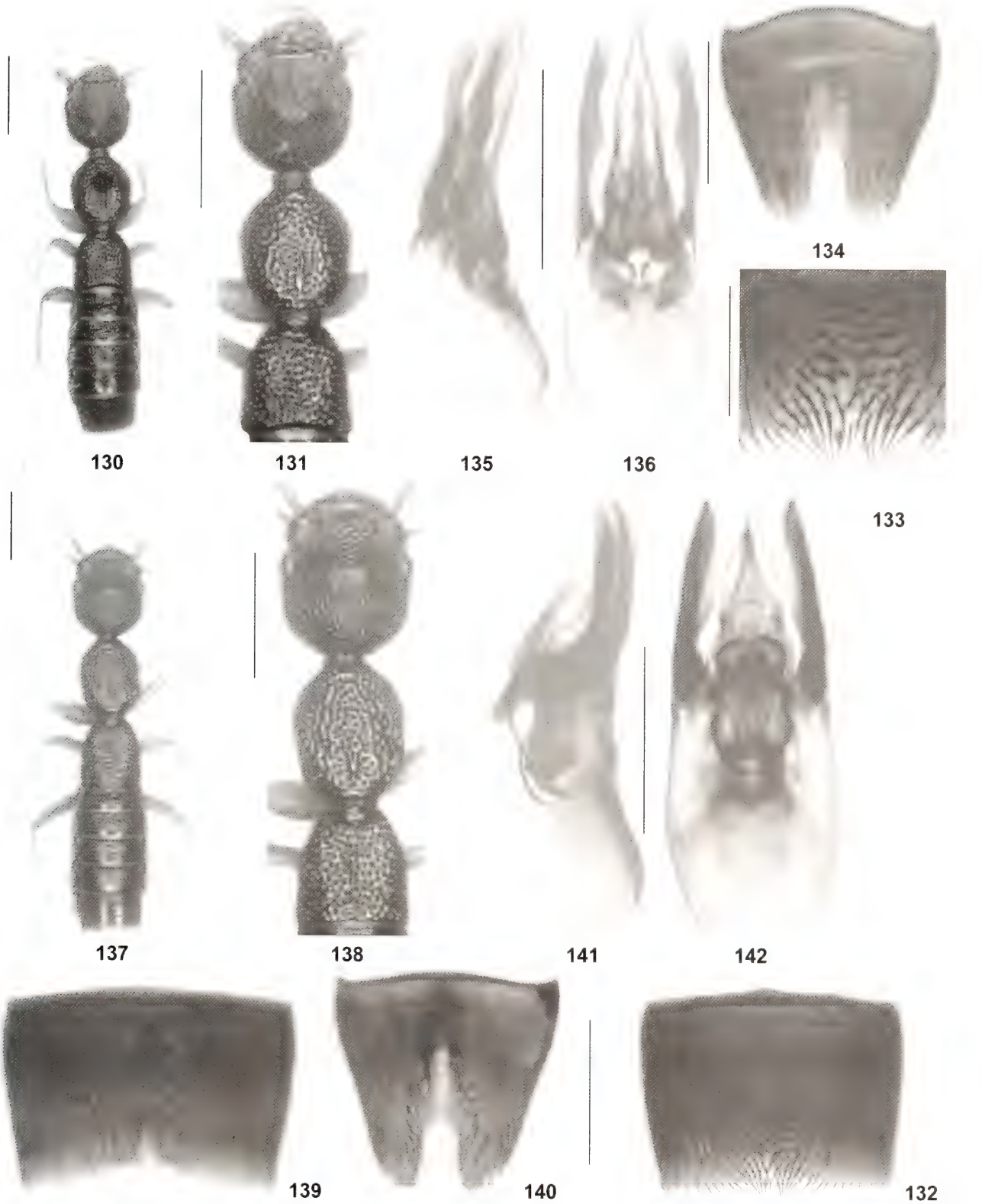

Figs 130–142. *Nazeris barbatus* **(130–136)** and *N. firmilobatus* **(137–142). 130, 137:** habitus; **131, 138:** forebody; **132, 139:** male sternite VII; **133:** postero-median portion of male sternite VII; **134, 140:** male sternite VIII; **135–136, 141–142:** aedeagus in lateral and in ventral view. Scale bars: 130–131, 137–138: 1.0 mm; 132, 134–136, 139–142: 0.5 mm, 133: 0.2 mm.

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Etymology. The specific epithet (Latin, adjective: bearded) refers to the conspicuous cluster of modified setae on the male sternite VII.

Description. Body length 5.2–5.7 mm; length of forebody 2.8–3.1 mm. Habitus as in Fig. 130. Coloration: forebody dark-brown; abdomen blackish-brown; legs yellowish; antennae yellowish, with antennomere I slightly darker. Other external characters (Fig. 131) as in *N. peniculatus*, except for the on average shallower punctation of the head.

♂: sternite VII (Fig. 132) with postero-median impression, this impression with a cluster of distinctly modified short and stout black setae (Fig. 133), posteriorly with dense long black setae, posterior margin in the middle with distinct concavity, middle of this concavity with a triangular projection; sternite VIII (Fig. 134) approximately as long as broad, posterior excision deep and narrowly U-shaped, approximately one third as deep as length of sternite; aedeagus (Figs 135–136) approximately 1.05 mm long; ventral process long, narrow and apically very acute in ventral view; dorso-lateral apophyses slender, somewhat dilated in the middle, apically obliquely truncate, and not reaching apex of ventral process.

Comparative notes. As can be inferred from the similar external and particularly the similar male sexual characters, above all the similarly derived chaetotaxy of the male sternite VII (unique among the *Nazeris* species known from Yunnan) and the similarly derived morphology of the aedeagus (long and slender ventral process), *N. barbatus* is most closely related to *N. peniculatus*, from which it differs by the median projection in the posterior concavity of the male sternite VII, the less deep posterior excision of the male sternite VIII, and the longer aedeagus with differently shaped dorso-lateral apophyses.

Distribution and natural history. The type locality is situated in the Wuliang Shan, to the northwest of Weishan, Yunnan (Fig. 89). The specimens were sifted from litter and old flood debris at an altitude of 1900 m.

***Nazeris firmilobatus* sp. n.** (Figs 90, 137–142)

Type material. Holotype ♂: "P.R. CHINA, Yunnan, E slope N Gaoligongshan, N27°45'40.8" E098°35'03.2", 03.vi.2010, 2536 m, sifting 27, V. Grebennikov / Holotypus ♂ *Nazeris firmilobatus* sp. n. det. V. Assing 2013" (CAS). Paratypes: 2♂, 3♀: same data as holotype (CAS, cSme, cAss); 2♂, 3♀: "P.R. CHINA, Yunnan, E slope N Gaoligongshan, N27°45'27.1" E098°35'34.5", 02.vi.2010, 2600 m, sifting26, V. Grebennikov" (CAS, cSme, cAss); 2♂, 1♀: "P.R. CHINA, Yunnan, E slope N Gaoligongshan, N27°46.8' E098°33.1', 12–15.vi.2009, 2000–3000 m, sifting1–7, V. Grebennikov" (CAS, cSme, cAss).

Etymology. The specific epithet is an adjective composed of the Latin adjectives firmus (stout, firm) and lobatus (lobed). It refers to the stout dorso-lateral apophyses of the aedeagus.

Description. Body length 6.0–7.0 mm; length of forebody 3.3–3.6 mm. Habitus as in Fig. 137. Coloration: body blackish-brown to blackish; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 138) approximately 1.05 times as long as broad; median dorsal portion more or less distinctly elevated; punctation coarse, dense, and umbilicate; interstices without microsculpture; eyes moderately small, less than one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 2.0 mm long.

Pronotum (Fig. 138) approximately 1.2 times as long as broad and 0.85 times as broad as head; punctation very dense, coarser than that of head, non-umbilicate; interstices glossy; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 138) approximately 0.6 times as long as pronotum; humeral angles obsolete; punctation dense, defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.25 times as broad as elytra; punctation dense, defined, and coarse on tergites III–VI, less dense and less coarse on tergite VII, finer and sparser on tergite VIII; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII convex.

♂: sternite VII (Fig. 139) with small postero-median impression, posterior margin distinctly concave in the middle; sternite VIII (Fig. 140) approximately as long as broad, with narrow, but long and distinct median impression, posterior excision deep and rather narrow, approximately one third as deep as length of sternite; aedeagus (Figs 141–142) approximately 1.1 mm long; ventral process narrow and apically acute in ventral view, laterally compressed; dorso-lateral apophyses stout, somewhat extending beyond apex of ventral process.

Comparative notes. *Nazeris firmilobatus* is readily distinguished from the four previously described species distributed in the Gaoligong Shan by the distinctly stouter and nearly straight dorso-lateral apophyses of the aedeagus.

Distribution and natural history. The species was found in three geographically close localities in the northern Gaoligong Shan (Fig. 90). The specimens with specified altitudes on the labels were sifted at elevations of approximately 2540 and 2600 m.

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***Nazeris spiculatus* sp. n.** (Figs 90, 143–149)

Type material. Holotype ♂: "CHINA: Yunnan [CH07-19], Dehong Dai Aut. Pref., mountain range 31 km E Luxi, 2280 m, 24°29'31"N, 98°52'58"E, secnd. pine forest with old decid. trees, litter sifted, 3.VI.3007, M. Schülke / Holotypus ♂ *Nazeris spiculatus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 1♂, 3♀: same data as holotype (cSch, cAss); 2♂, 1♀: same data, but leg. A. Pütz (cPüt, cAss).

Etymology. The specific epithet is an adjective derived from the Latin noun spiculum (thorn, spine) and refers to the shape of the ventral process of the aedeagus in ventral view.

Description. Body length 6.2–7.3 mm; length of forebody 3.4–3.8 mm. Habitus as in Fig. 143. Coloration: body blackish-brown to blackish, with the elytra occasionally paler; legs yellowish; antennae yellowish, with antennomere I slightly darker. External characters (Fig. 144) as in *N. firmilobatus*, except for the denser punctation of the abdominal tergite VII.

♂: sternite VII (Fig. 145) with small postero-median impression, posterior margin distinctly concave; sternite VIII (Fig. 146) approximately as long as broad, with distinct median impression, posterior excision deep and narrowly U-shaped, approximately one third as deep as length of sternite; aedeagus (Figs 147–149) approximately 1.1 mm long; ventral process narrow and apically acute in ventral view, laterally strongly compressed; dorso-lateral apophyses basally strongly dilated and apically slender, just reaching the apex of the ventral process.

Comparative notes. The similar external and male sexual characters suggest that *N. spiculatus* is closely allied to *N. firmilobatus*, *N. curvus*, and allied species, from which it is reliably distinguished only by the shapes of the male sternites VII and VIII, as well as by the morphology of the aedeagus.

Distribution and natural history. The type locality is situated to the east of Luxi, western Yunnan (Fig. 90). The specimens were sifted from litter in a secondary pine forest with old deciduous trees at an altitude of 2280 m.

***Nazeris curvus* sp. n.** (Figs 89, 150–155)

Type material. Holotype ♂: "CHINA (Yunnan) Baoshan Pref., Gaoligong Shan nr. Xiaoheishan N.R., 35 km SE Tengchong, 2110 m, 24°50'16"N, 98°45'43"E (prim. decid. forest, litter, sifted) 30.V.–14.VI.2007 D.W. Wrase [11] / Holotypus ♂ *Nazeris curvus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 1♂: "CHINA: Yunnan [CH07-13A], Baoshan Pref., Gaoligong Shan, E pass, 36 km SE Tengchong, 2200 m, 24°49'32"N, 98°46'06"E, decid. forest, litter, wood, fungi sifted, 4.VI.2007, M. Schülke" (cSch); 1♀: same data, but "[CH07-13] ... 31.V.2007" (cSch); 1♀: "CHINA: Yunnan, Baoshan Pref., Gaoligong Shan, 32 km SE Tengchong, 2150–2250 m, 24°51-53'N, 98°45'E, devast. prim. and second. forest, litter, dead wood, mushrooms sifted, 26.VIII.2009, leg. M. Schülke [CH09-08/09]" (cSch); 1♀: "CHINA: Yunnan, Baoshan Pref., Gaoligong Shan, W pass 35 km SE Tengchong, 2100 m, 24°50'18"N, 98°45'43"E, devast. prim. dec. forest, litter, wood, mushrooms sifted, 28.VIII.2009, leg. M. Schülke [CH09-06a]" (cSch); 1♂: "CHINA: Yunnan [CH07-14A], Baoshan Pref., Gaoligong Shan, 33 km SE Tengchong, 2100–2200 m, 24°51'22"N, 98°45'36"E, decid. forest, litter, wood, fungi sifted, 4.VI.2007, M. Schülke" (cAss); 1♀: "CHINA: Yunnan [CH07-15], Baoshan Pref., Gaoligong Shan, 29 km ESE Tengchong, 2350 m, 24°55'37"N, 98°45'09"E, dev. decid forest, litter, wood, fungi sifted, 1.VI.2007, leg. A. Pütz" (cPüt).

Etymology. The specific epithet (Latin, adjective: curved) alludes to the strongly curved dorso-lateral apophyses of the aedeagus.

Description. Body length 6.0–6.6 mm; length of forebody 3.1–3.5 mm. Habitus as in Fig. 150. Coloration: body blackish-brown to black; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 151) weakly oblong, 1.01–1.03 times as long as broad; median dorsal portion elevated; punctation moderately coarse and shallow, very dense, and distinctly umbilicate; interstices without microsculpture, reduced to very narrow ridges; eyes rather small, less than one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 2.0 mm long.

Pronotum (Fig. 151) approximately 1.15–1.20 times as long as broad and 0.85–0.90 times as broad as head; punctation very dense, coarse, much coarser than that of head, non-umbilicate; interstices glossy, but very narrow; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 151) approximately 0.55 times as long as pronotum; humeral angles nearly obsolete; punctation dense, defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.2 times as broad as elytra; punctation very dense, defined, and coarse on tergites III–VI, only slightly less dense and less coarse on tergite VII, finer and sparser on tergite VIII; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII strongly convex.

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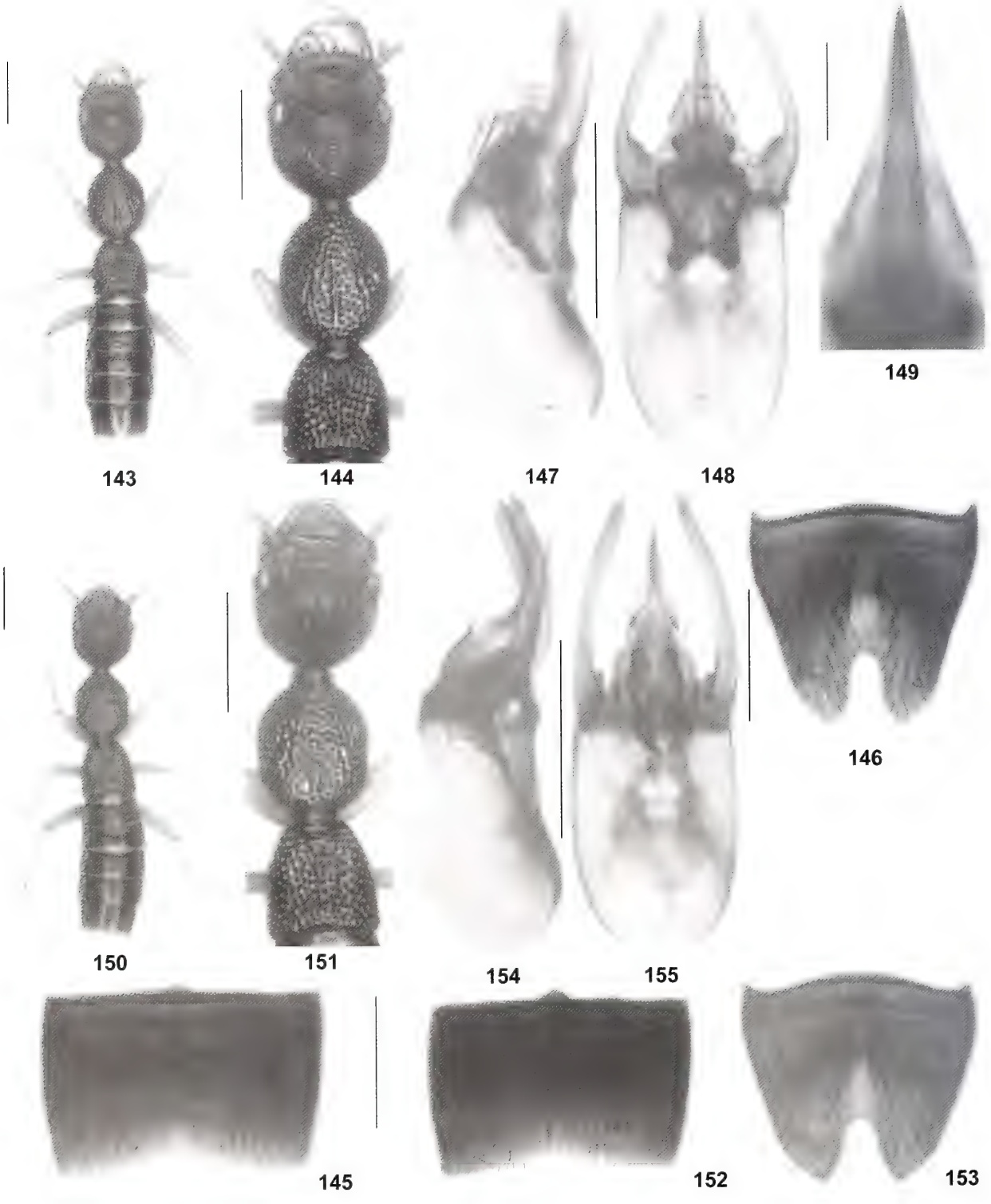

Figs 143–155. *Nazeris spiculatus* (**143–149**) and *N. curvus* (**150–155**). **143, 150:** habitus; **144, 151:** forebody; **145, 152:** male sternite VII; **146, 153:** male sternite VIII; **147–148, 154–155:** aedeagus in lateral and in ventral view; **149:** ventral process of aedeagus in ventral view. Scale bars: 143–144, 150–151: 1.0 mm; 145–148, 152–155: 0.5 mm, 149: 0.1 mm.

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♂: sternite VII (Fig. 152) with small postero-median impression, posterior margin weakly concave; sternite VIII (Fig. 153) approximately 1.05 times as broad as long and with oblong median impression, posterior excision rather deep and moderately narrow, approximately 0.3 times as deep as length of sternite; aedeagus (Figs 154–155) approximately 1.05 mm long; ventral process narrow and apically acute in ventral view, laterally somewhat compressed; dorso-lateral apophyses stout, strongly curved in lateral view, and slightly extending beyond apex of ventral process.

Comparative notes. The only other species with strongly curved dorso-lateral apophyses in the Gaoligong Shan is the geographically close *N. nomurai* Watanabe & Xiao, 2000 (type locality: "Lujiangba, Gaoligong Shan Mts., Baoshan area"), from which *N. curvus* differs by the much more slender ventral process (ventral view) and by the apically only weakly modified dorso-lateral apophyses. Based on the illustrations provided by Watanabe & Xiao (2000), it seems likely that the types of *N. nomurai* and specimens from "Dabei" listed as additional material, but not included in the type series, are not conspecific.

Distribution and natural history. The known distribution of *N. curvus* is confined to several geographically close localities to the southeast of Tengchong in the Gaoligong Shan (Fig. 89). The specimens were sifted from leaf litter in primary and secondary deciduous forests at altitudes of 2100–2350 m, in one locality together with *N. circumclusus*.

***Nazeris infractus* sp. n.** (Figs 90, 156–162)

Type material. Holotype ♂: "CHINA: Yunnan [CH07-30], Nujiang Lisu Aut. Pref., Nu Shan, 7 km NNW Coajian, 25°43'29"N, 99°07'57"E, 2420 m, second. pine forest with shrubs, litter, bark sifted, 11.VI.2007, M. Schülke / Holotypus ♂ *Nazeris infractus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 2♀: same data as holotype (cSch); 1♀: same data, but leg. Wrase (cSch); 1♀: same data, but leg. Pütz (cPüt).

Etymology. The specific epithet is the past participle of the Latin verb infringere (to bend, to break) and alludes to the apically abruptly bent dorso-lateral apophyses of the aedeagus.

Description. Body length 6.0–6.2 mm; length of forebody 3.2–3.5 mm. Habitus as in Fig. 156. Coloration: body blackish; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 157) as broad as long or weakly oblong; median dorsal portion elevated; punctation moderately coarse and shallow, very dense, and distinctly umbilicate; interstices without microsculpture, reduced to very narrow ridges; eyes moderately small, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 2.0 mm long.

Pronotum (Fig. 157) approximately 1.15–1.20 times as long as broad and approximately 0.85 times as broad as head; punctation very dense, much coarser than that of head, non-umbilicate; interstices glossy, but narrow; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 157) approximately 0.55 times as long as pronotum; humeral angles nearly obsolete; punctation dense, defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.2 times as broad as elytra; punctation very dense, defined, and coarse on tergites III–VI, only slightly less dense and less coarse on tergite VII, finer and sparser on tergite VIII; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII strongly convex.

♂: sternite VII (Fig. 158) with postero-median impression, posterior margin distinctly concave in the middle; sternite VIII (Fig. 159) approximately 1.1 times as broad as long and with oblong median impression, posterior excision rather deep and narrowly V-shaped, approximately one third as deep as length of sternite; aedeagus (Figs 160–162) 0.95 mm long; ventral process basally of moderate width and apically acute in ventral view, laterally somewhat compressed; dorso-lateral apophyses stout, apically abruptly bent, and slightly extending beyond apex of ventral process.

Comparative notes. In external morphology, this species is highly similar to *N. curvus*. It is distinguished from all its congeners particularly by the conspicuous shape of the dorso-lateral apophyses of the aedeagus, from *N. curvus* additionally by the medially distinctly concave posterior margin of the male sternite VII, the deeper and differently shaped posterior excision of the male sternite VIII, and by the much broader ventral process of the smaller aedeagus.

Distribution and natural history. The type locality is situated in the Nu Shan, to the north-northwest of Coajian (Fig. 90). The specimens were sifted from leaf litter in a secondary pine forest with shrubs at an altitude of 2420 m. One of the females is teneral.

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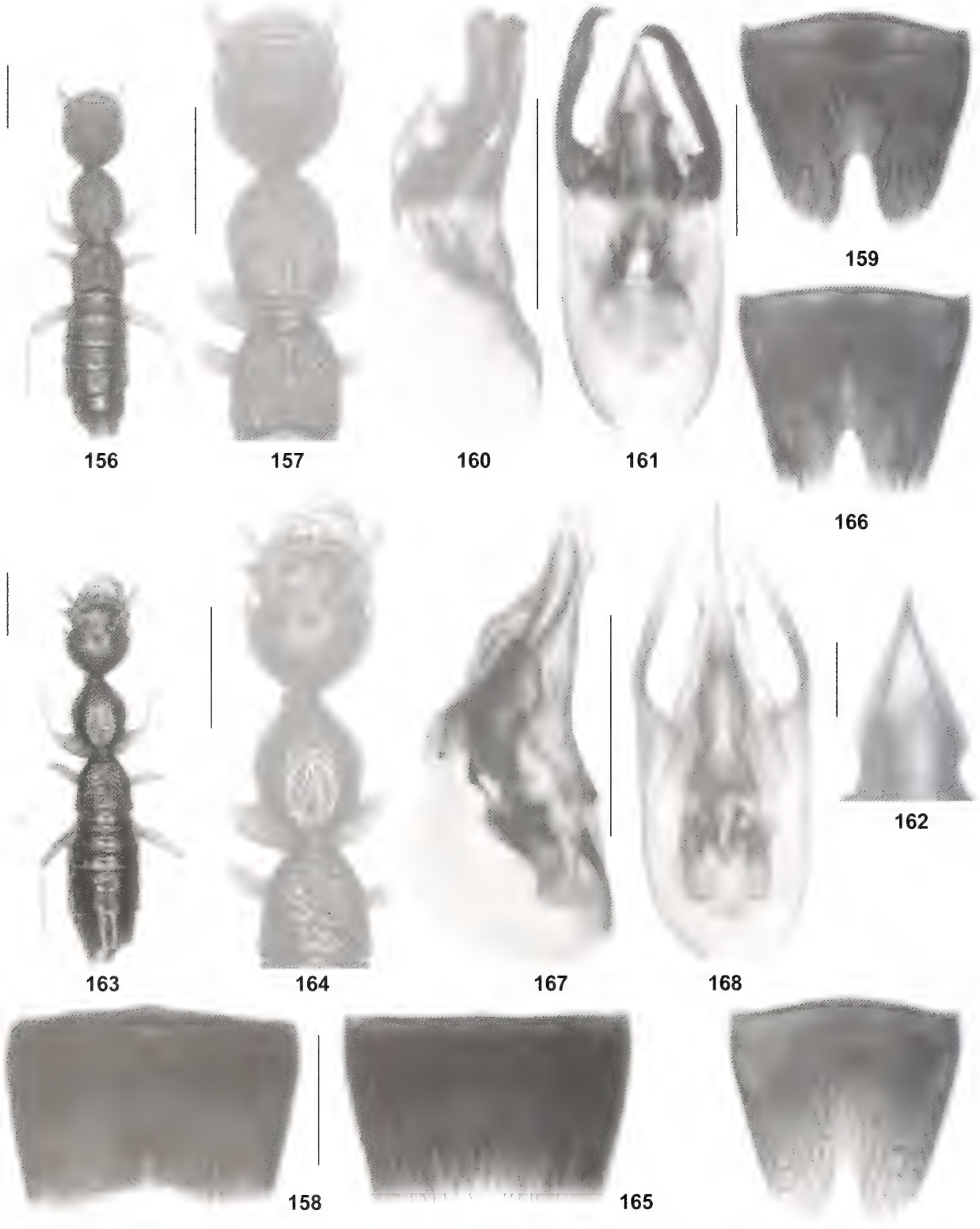

Figs 156–169. *Nazeris infractus* (**156–162**), *N. subdentatus* (**163–168**), and *N. vexillatus* (**169**). **156, 163:** habitus; **157, 164:** forebody; **158, 165:** male sternite VII; **159, 166, 169:** male sternite VIII; **160–161, 167–168:** aedeagus in lateral and in ventral view; **162:** ventral process of aedeagus in ventral view. Scale bars: 156–157, 163–164: 1.0 mm; 158–161, 165–169: 0.5 mm, 162: 0.1 mm.

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***Nazeris subdentatus* sp. n.** (Figs 89, 163–168)

Type material. Holotype ♂: "CHINA: Yunnan, Nujiang Lisu Pref., Gaoligong Shan, "Cloud pass" 21 km NW Liuku, 3150 m, 25°58'21"N, 98°41'01"E, shrubs & bamboo, litter sifted, 2.IX.2009, leg. M. Schülke [CH09-22] / Holotypus ♂ *Nazeris subdentatus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 1♂: same data as holotype (cSch); 2♀: "CHINA: Yunnan [CH07-27], Nujiang Lisu Aut. Pref., Gaoligong Shan, creek valley 20 km NW Liuku, 25°58'49"N, 98°41'48"E, 3000 m, bamboo, shrubs, litter sifted, 9.VI.2007, M. Schülke" (cSch, cAss); 1♂ [slightly teneral]: "CHINA: Yunnan [CH07-28], Nujiang Lisu Aut. Pref., Gaoligong Shan, side valley 19 km NW Liuku, 25°59'02"N, 98°42'43"E, 2730 m, devast. prim. forest, litter sifted, 9.VI.2007, leg. A. Pütz" (cPüt).

Etymology. The specific epithet (Latin, adjective) alludes to the dentate ventral process of the aedeagus, a character distinguishing this species from all its geographically close congeners.

Description. Body length 6.2–7.5 mm; length of forebody 3.5–5.7 mm. Habitus as in Fig. 163. Coloration: body black; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 164) 1.05–1.10 times as long as broad; median dorsal portion elevated; punctation coarse, moderately dense, and non-umbilicate; interstices without microsculpture, glossy; eyes moderately small, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 2.0–2.3 mm long.

Pronotum (Fig. 164) small in relation to head, approximately 1.15 times as long as broad and 0.80–0.85 times as broad as head; punctation similar to that of head, but slightly less dense; interstices glossy; midline with very short elevated impunctate band posteriorly.

Elytra (Fig. 164) approximately 0.6 times as long as pronotum, of conspicuously trapezoid shape, i.e., posteriorly strongly dilated and with completely obsolete humeral angles; punctation dense, defined, and somewhat coarser than that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.25 times as broad as elytra, strongly widened from segment III to segment VI; punctation dense, defined, and coarse on tergites III–VI, only slightly less dense and less coarse on tergite VII, finer and sparser on tergite VIII; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII convex.

♂: posterior margin of sternite VII with small median concavity (Fig. 165); sternite VIII (Fig. 166) approximately 1.1 times as broad as long, posterior excision deep and narrowly V-shaped, approximately one third as deep as length of sternite; aedeagus (Figs 167–168) approximately 1.05 mm long; ventral process narrow in basal half, sharply edged in apical half, and apically very acute in ventral view, with small subapical tooth in lateral view; dorso-lateral apophyses simple, rather short, not reaching apex of ventral process.

Comparative notes. *Nazeris subdentatus* is distinguished from all its geographically close congeners by the conspicuously trapezoid shape of the elytra, by the shape of the male sternite VIII, and particularly by the shape of the ventral process of the aedeagus (extending beyond dorso-lateral apophyses; ventral portion sharply edged in apical half; subapically dentate in lateral view).

Distribution and natural history. The species was found in two geographically close localities in the northern Gaoligong Shan, to the northwest of Liuku (Fig. 89). The specimens were sifted from leaf litter in vegetation composed of shrubs and bamboo and in a degraded primary forest at altitudes of 2730–3150 m.

***Nazeris meilicus* sp. n.** (Figs 90, 170–176)

Type material. Holotype ♂: "CHINA: N-Yunnan [C2005-07A], Diqing Tibet. Aut. Pref., Deqin Co., Meili Xue Shan, E-side, 12 km SW Deqin, 2890 m, 28°25.30'N, 98°48.47'E / small creek valley, mixed forest with bamboo, leaf litter, moss, dead wood, sifted, 13.VI.2005, leg. M. Schülke [C2005-07A] / Holotypus ♂ *Nazeris meilicus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 2♀: same data as holotype (cSch, cAss); 1♂: "CHINA (N-Yunnan) Diqing Tibet. Aut. Pref., Deqin Co., Meili Xue Shan, E-side, 12 km SW Deqin, 2890 m, 28°25.30'N, 98°48.47'E, creek valley (mixed forest, under wood, stones, in litter/soil) 9.&13.VI.2005, D.W. Wrase [07]" (cSch); 1♂, 2♀: "CHINA: N-Yunnan [C2005-09], Diqing Tibet. Aut. Pref., Deqin Co., Meili Xue Shan, E-side, 14 km W Deqin, 2580 m / 28°27.47'N, 98°46.35'E, creek valley below glacier, mixed forest, leaf litter, moss, dead wood, sifted, 11.VI.2005, leg. M. Schülke [C2005-09]" (cSch); 1♂, 2♀: "CHINA: N-Yunnan Diqing Tibet. Aut. Pr. Deqin Co. Meili Xue Shan E-side 12 km SW Deqin, 28°25.30'N, 98°48.47'E 2890 m, 13.VI.2005 A. Smetana [C160]" (cSme, cAss); 1♂: same data, but "9.VI.2005 ... [C156]" (cAss); 1♀: "CHINA: N-Yunnan Diqing Tibet. Aut. Pr. Deqin Co. Meili Xue Shan E-side 14 km W Deqin, 28°27.47'N, 98°46.35'E 2580 m, 11.VI.2005 A. Smetana [C158]" (cSme).

Etymology. The specific epithet is an adjective derived from the name of the mountain where this species was discovered.

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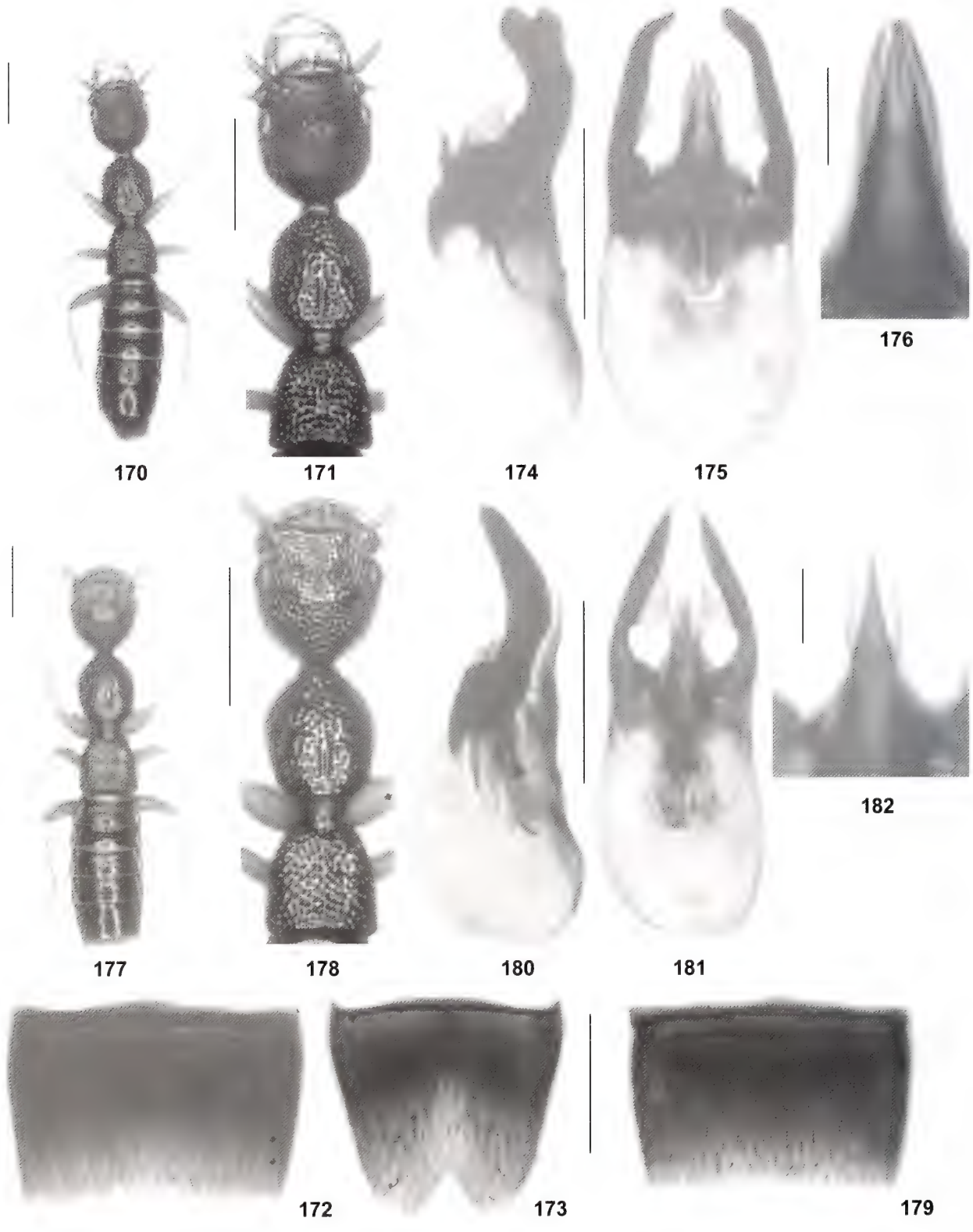

Figs 170–182. *Nazeris meilicus* (**170–176**) and *N. vexillatus* (**177–182**). **170, 177:** habitus; **171, 178:** forebody; **172, 179:** male sternite VII; **173:** male sternite VIII; **174–175, 180–181:** aedeagus in lateral and in ventral view; **176, 182:** ventral process of aedeagus in ventral view. Scale bars: 170–171, 177–178: 1.0 mm; 172–175, 179–181: 0.5 mm, 176, 182: 0.1 mm.

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Description. Body length 5.5–6.7 mm; length of forebody 3.3–3.5 mm. Habitus as in Fig. 170. Coloration: forebody dark-brown to black; abdomen black; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 171) 1.05–1.10 times as long as broad; median dorsal portion weakly elevated; punctation moderately coarse, dense, and umbilicate; interstices without microsculpture, forming very narrow ridges; eyes relatively weakly convex, weakly projecting from lateral contours of head, less than one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 2.0 mm long.

Pronotum (Fig. 171) approximately 1.2 times as long as broad and 0.85 times as broad as head; punctation very dense, much coarser than that of head, non-umbilicate; interstices glossy, forming narrow ridges; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 171) approximately 0.6 times as long as pronotum; humeral angles obsolete; punctation dense, defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.2 times as broad as elytra; punctation dense, defined, and coarse on tergites III–VI, distinctly finer and sparser on tergites VII and VIII; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII convex.

♂: sternite VII (Fig. 172) with weakly concave posterior margin, otherwise unmodified; sternite VIII (Fig. 173) approximately 1.1 times as broad as long, posterior excision broadly V-shaped, approximately 0.2 times as deep as length of sternite; aedeagus (Figs 174–176) approximately 1.0 mm long; ventral process moderately short and slender, apically acute in ventral view; dorso-lateral apophyses stout, strongly sclerotized, triangularly dilated in the middle, curved dorsad in lateral view, and distinctly extending beyond apex of ventral process.

Comparative notes. This species is characterized particularly by the moderately deep and broadly V-shaped posterior excision of the male sternite VIII and by the distinctive shape of the dorso-lateral apophyses of the aedeagus. The morphology of the aedeagus, in particular the stout and subapically abruptly bent dorso-lateral apophyses, is most similar to that of *N. infractus*, but the shapes of the male sternites VII and VIII are rather different.

Distribution and natural history. *Nazeris meilicus* was collected in two localities in the Meili Xue Shan in western Yunnan (Fig. 90). The specimens were sifted from litter in mixed forests at altitudes of 2580 and 2890 m.

***Nazeris vexillatus* sp. n.** (Figs 90, 169, 177–182)

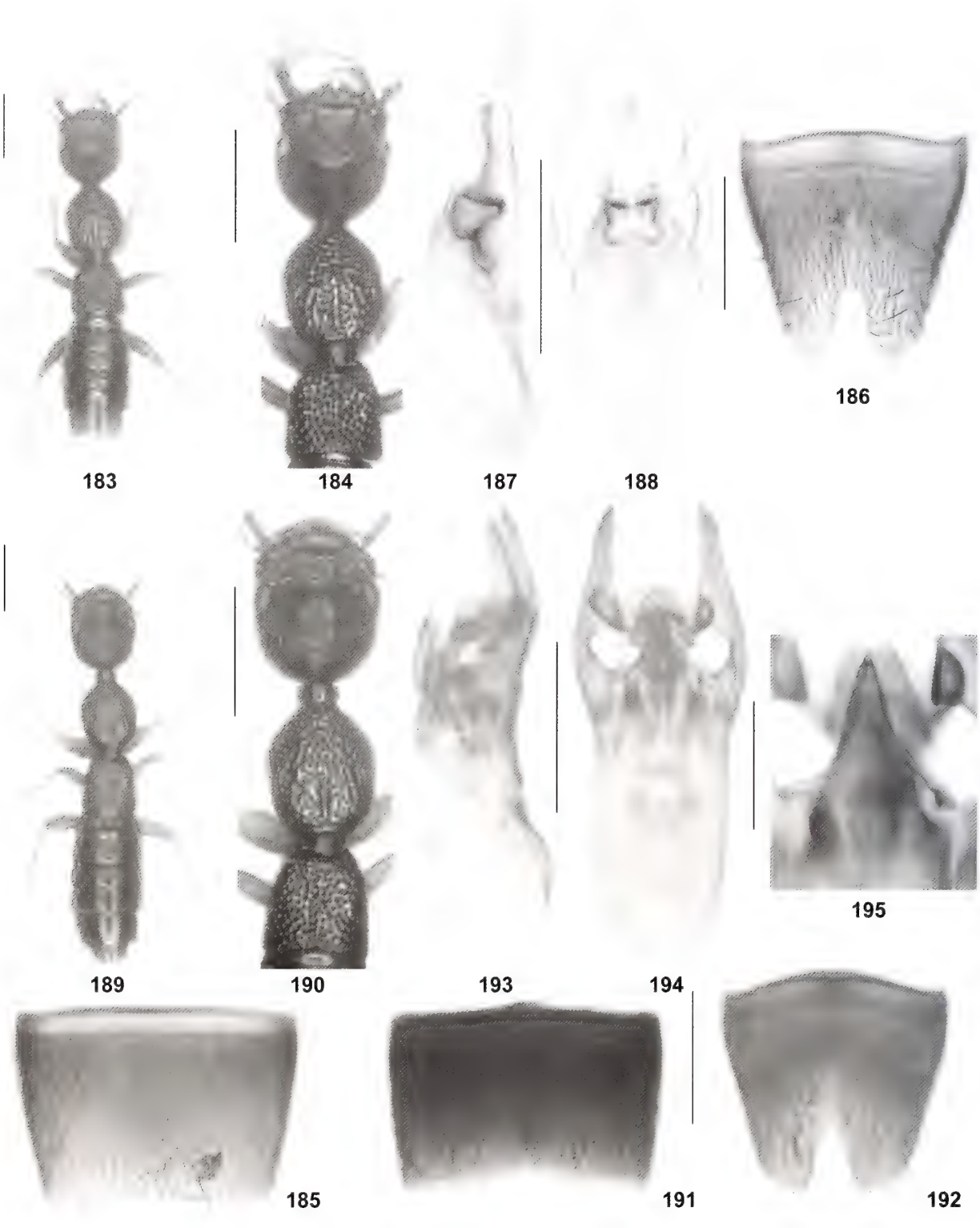
Type material. Holotype ♂: "CHINA: Yunnan, Lujiang Lisu Pref., Gaoligong Shan, "Cloud pass", 21 km NW Liuku, 25°58'21"N, 98°41'01"E, 3150 m, shrubs & bamboo, litter sifted, 3.IX.2009, leg. M. Schülke [CH09-22a] / Holotypus ♂ *Nazeris vexillatus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 4♂, 1♀: same data as holotype (cSch, cAss); 1♀: "CHINA (Yunnan) Lujiang Lisu Pref., Gaoligong Shan "Cloud pass" 3150 m, 21 km NW Liuku (shrubs, *Vaccinium*, bamboo, litter sifted) 25°58'21"N, 98°41'01"E, 2.IX.2009 D.W. Wrase [22A]" (cSch); 1♂: "CHINA: Yunnan, Lujiang Lisu Pref., Gaoligong Shan, "Cloud pass", 21 km NW Liuku, 25°58'21"N, 98°41'01"E, 3150 m, shrubs & bamboo, litter sifted, 2.IX.2009, leg. M. Schülke [CH09-22]" (cAss); 1♂, 2♀: "CHINA: Yunnan [CH07-28A], Nujiang Lisu Aut. Pref., Gaoligong Shan, side valley 19 km NW Liuku, 25°59'02"N, 98°42'23"E, 2730 m, devast. prim. for., litter sifted, 10.VI.2007, M. Schülke" (cSch, cAss); 1♂: "CHINA: Yunnan [CH07-28], Nujiang Lisu Aut. Pref., Gaoligong Shan, side valley 19 km NW Liuku, 25°59'02"N, 98°42'23"E, 2730 m, devast. prim. forest, litter sifted, 9.VI.2007, M. Schülke" (cSch); 1♀: "CHINA: Yunnan [CH07-27], Nujiang Lisu Aut. Pref., Gaoligong Shan, creek valley 20 km NW Liuku, 25°58'49"N, 98°41'48"E, 3000 m, bamboo, shrubs, litter sifted, 9.VI.2007, M. Schülke" (cAss); 1♂ [teneral]: "CHINA (Yunnan) Lujiang Lisu Pref., Gaoligong Shan E pass 20 km NW Liuku, 3000 m (creek valley with devast. prim. forest, ferns, litter and moss sift.) 25°58'49"N, 98°41'48"E, 3.IX.2009 D.W. Wrase [25]" (cSch).

Etymology. The specific epithet is an adjective derived from the Latin noun vexillum (small flag, banneret) and alludes to the conspicuous lamellate processes of the dorso-lateral apophyses of the aedeagus.

Description. Body length 5.2–6.7 mm; length of forebody 2.9–3.4 mm. Habitus as in Fig. 177. Coloration: head and pronotum reddish-brown to dark-brown; elytra reddish to dark-reddish; abdomen dark-brown to blackish-brown; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 178) approximately 1.05 times as long as broad; median dorsal portion more or less distinctly elevated; punctation coarse, dense, and moderately umbilicate; interstices without microsculpture; eyes moderately small, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna 1.7–1.9 mm long.

Pronotum (Fig. 178) approximately 1.15 times as long as broad and 0.85 times as broad as head; punctation coarser and somewhat sparser than that of head, non-umbili-



Figs 183–195. *Nazeris circumclusus* **(183–188)** and *N. hastatus* **(189–195). 183, 189:** habitus; **184, 190:** forebody; **185, 191:** male sternite VII; **186, 192:** male sternite VIII; **187–188, 193–194:** aedeagus in lateral and in ventral view; **195:** ventral process of aedeagus in ventral view. Scale bars: 183–184, 189–190: 1.0 mm; 185–188, 191–194: 0.5 mm, 195: 0.2 mm.

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cate; interstices glossy; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 178) approximately 0.6 times as long as pronotum; humeral angles obsolete; punctation dense, defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.2 times as broad as elytra; punctation dense, defined, and moderately coarse on tergite III, gradually becoming less dense and finer towards posterior tergites, moderately sparse and fine on tergite VII, even finer and sparser on tergite VIII; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII strongly convex.

♂: sternite VII (Fig. 179) with truncate posterior margin; sternite VIII (Fig. 169) weakly transverse, posterior excision moderately deep and rather narrowly V-shaped, approximately 0.25 times as deep as length of sternite; aedeagus (Figs 180–182) 0.9–1.0 mm long; ventral process gradually narrowed apicad, apically acute, and basally with lateral projections in ventral view, laterally compressed; dorso-lateral apophyses long, distinctly extending beyond apex of ventral process, flattened, and strongly dilated, in the middle with conspicuous lamellate processes (ventral view).

Comparative notes. This species is characterized by its brownish coloration and particularly by the highly distinctive morphology of the aedeagus, above all by the conspicuous processes of the dorso-lateral apophyses. Together with the following two species, *N. vexillatus* forms a group characterized by the coloration (body not black), the coarse punctation of the pronotum and the elytra, a weakly modified male sternite VII (without postero-median impression, posterior margin weakly concave), the shape of the male sternite VIII (approximately as long as broad; posterior excision moderately deep), and particularly by the morphology of the aedeagus (ventral process short and of triangular shape in ventral view; dorso-lateral apophyses modified: long, distinctly extending beyond the apex of the ventral process, and dilated in various ways).

Distribution and natural history. *Nazeris vexillatus* is currently known only from the region to the northwest of Liuku in the Gaoligong Shan (Fig. 90). The specimens were sifted from leaf litter and moss in degraded primary forests and in shrub habitats with bamboo at altitudes of 2730–3150 m. One male collected in the beginning of September is teneral.

***Nazeris circumclusus* sp. n.** (Figs 90, 183–188)

Type material. Holotype ♂ [teneral]: "CHINA: Yunnan, Baoshan Pref., Gaoligong Shan, 32 km SE Tengchong, 2150–2250 m, 24°51-53'N, 98°45'E, devast. prim. and second. forest, litter, dead wood, mushrooms sifted, 26.VIII.2009, leg. M. Schülke [CH09-08/09] / Holotypus ♂ *Nazeris circumclusus* sp. n. det. V. Assing 2013" (cAss).

Etymology. The specific epithet (Latin, adjective: enframed, surrounded) alludes to the ventral process of the aedeagus, whose ventral portion is enframed by the posterior portion in ventral view.

Description. Body length 5.8 mm; length of forebody 3.3 mm. Habitus as in Fig. 183. Coloration (note that the holotype is teneral): body brown, with the apex of the abdomen paler; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 184) 1.05 times as long as broad; median dorsal portion weakly elevated; punctation rather shallow, dense, and distinctly umbilicate; interstices without microsculpture; eyes moderately small, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna 2.0 mm long.

Pronotum (Fig. 184) 1.17 times as long as broad and 0.85 times as broad as head; punctation distinctly coarser and somewhat irregularly spaced in postero-lateral portions, non-umbilicate; interstices glossy; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 184) nearly 0.6 times as long as pronotum; humeral angles obsolete; punctation dense, defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.2 times as broad as elytra; punctation dense, defined, and moderately coarse on anterior tergites, distinctly sparser and finer on tergite VII than on tergite VI; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII produced in the middle, obtusely angled.

♂: sternite VII (Fig. 185) with weakly concave posterior margin; sternite VIII (Fig. 186) approximately as long as broad, posterior excision rather deep and narrowly U-shaped, approximately 0.3 times as deep as length of sternite; aedeagus (Figs 187–188) 0.93 mm long; ventral process short, apically acute, and ventral portion conspicuously enframed by the ovoid posterior portion in ventral view; dorso-lateral apophyses long, at basal third with dilatation, and distinctly extending beyond apex of ventral process.

Comparative notes. Based on the external (coarse punctation, body not black) and the male sexual characters (weakly modified sternites VII and VIII; sternite VIII without median impression; aedeagus with short ventral process and with long, partly dilated dorso-lateral apophyses), *N. circumclusus* is closely allied to *N. vexillatus*, from

which it differs by the relatively larger and less convex head, the punctation of the head (less coarse, denser, and distinctly umbilicate), the longer and more slender antennae, the U-shaped posterior excision of the male sternite VIII, and by the morphology of the aedeagus (shapes of ventral process and of the dorso-lateral apophyses).

Distribution and natural history. The type locality is situated in the Gaoligong Shan, to the southeast of Tengchong (Fig. 90). The teneral holotype was sifted from leaf litter in a degraded mixed primary and secondary forest at an altitude of 2150–2250 m, together with *N. curvus*.

***Nazeris hastatus* sp. n.** (Figs 90, 189–195)

Type material. Holotype ♂: "CHINA (Yunnan) Nujiang Lisu Aut. Pref., Gaoligong Shan, side valley 18 km NW Liuku, 2590 m, 25°58'10"N, 98°42'27'E (devast. prim. forest, litter sifted) 9–10.VI.2007 D.W. Wrase [29] / Holotypus ♂ *Nazeris hastatus* sp. n. det. V. Assing 2013" (cAss).

Etymology. The specific epithet (Latin, adjective: armed with a spear) refers to the spear-shaped dorso-lateral apophyses of the aedeagus.

Description. Body length 6.2 mm; length of forebody 3.4 mm. Habitus as in Fig. 189. Coloration: body dark-brown, with the elytra paler brown; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 190) 1.05 times as long as broad; median dorsal portion elevated; punctation moderately coarse, dense, and weakly umbilicate; interstices without microsculpture; eyes of moderate size, approximately one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna 2.0 mm long.

Pronotum (Fig. 190) 1.2 times as long as broad and 0.85 times as broad as head; punctation distinctly coarser and somewhat irregularly spaced in postero-lateral portions, non-umbilicate; interstices glossy; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 190) 0.57 times as long as pronotum; humeral angles obsolete; punctation dense, defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen 1.25 times as broad as elytra; punctation dense, coarse on tergites III–V, somewhat finer on tergite VI, only slightly finer and sparser on tergite VII than on tergite VI; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII convex.

♂: sternite VII (Fig. 191) with weakly concave posterior margin; sternite VIII (Fig. 192) approximately as long as broad, posterior excision moderately deep and nearly U-shaped, 0.24 times as deep as length of sternite; aedeagus (Figs 193–195) 1.1 mm long; ventral process short, of triangular shape, and apically acute; dorso-lateral apophyses long and spear-shaped, strongly triangularly dilated in the middle, and distinctly extending beyond apex of ventral process.

Comparative notes. As can be inferred from the external (coarse punctation, body not black) and the male sexual characters (weakly modified sternites VII and VIII; sternite VIII without median impression; aedeagus with short ventral process and with long, partly dilated dorso-lateral apophyses), *N. hastatus* is closely related to *N. vexillatus* and *N. circumclusus*. It is distinguished from these species by the different punctation of the head (coarser than in *N. circumclusus*, less coarse and denser than in *N. vexillatus*), by the shape of the posterior excision of the male sternite VIII, and particularly by the morphology of the aedeagus, above all the conspicuous shape of the dorso-lateral apophyses.

Distribution and natural history. The type locality is situated in the Gaoligong Shan, to the northwest of Liuku (Fig. 90). The holotype was sifted from leaf litter in a degraded primary forest at an altitude of 2590 m.

***Nazeris bangmaicus* sp. n.** (Figs 90, 196–200)

Type material. Holotype ♂ [teneral]: "CHINA: Yunnan, Lincang Pref., Bangma Shan, 20 km NW Lincang, 2210 m, 23°58'25"N, 99°54'36"E, water reservoir, devast. forest with ferns, litter & ferns sifted, reservoir bank, 9.IX.2009, leg. M. Schülke [CH09-37] / Holotypus ♂ *Nazeris bangmaicus* sp. n. det. V. Assing 2013" (cAss). Paratype: 1♀: same data as holotype (cSch).

Etymology. The specific epithet is an adjective derived from the name of the mountain where this species was discovered.

Description. Body length 5.6–5.7 mm; length of forebody 3.1–3.3 mm. Habitus as in Fig. 196. Coloration: forebody blackish-brown; abdomen black; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 197) indistinctly transverse, 1.01–1.03 times as broad as long, of subcircular outline in dorsal view; median dorsal portion very weakly elevated; punctation moderately coarse, dense, and umbilicate; interstices without microsculpture, forming very narrow ridges; eyes relatively small, weakly projecting from lateral contours of head, distinctly less than one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 1.8 mm long.

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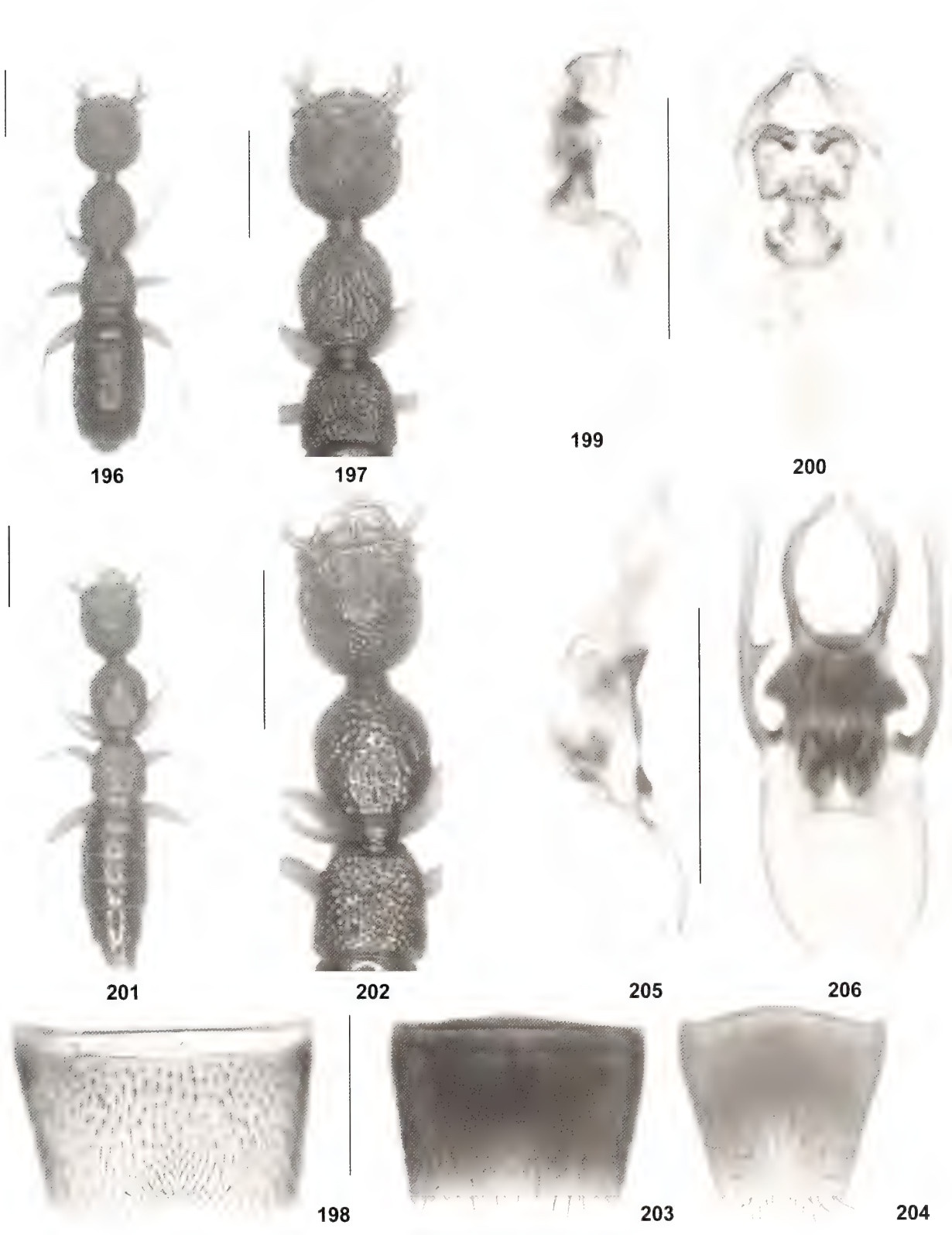

Figs 196–206. *Nazeris bangmaicus* (**196–200**) and *N. fissus* (**201–206**). **196, 201:** habitus; **197, 202:** forebody; **198, 203:** male sternite VII; **199–200, 205–206:** aedeagus in lateral and in ventral view; **204:** male sternite VIII. Scale bars: 196–197, 201–202: 1.0 mm; 198–200, 203–206: 0.5 mm.

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Pronotum (Fig. 197) approximately 1.15 times as long as broad and 0.85 times as broad as head; punctation very dense, much coarser than that of head, non-umbilicate; interstices glossy, forming narrow ridges; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 197) very short, approximately 0.5 times as long as pronotum; humeral angles obsolete; punctation dense, defined, and approximately as coarse as that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen 1.25–1.30 times as broad as elytra; punctation dense, defined, and coarse on tergites III–VI, somewhat less dense and less coarse on tergite VII, finer and sparser on tergite VIII; interstices without microsculpture; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII convex.

♂: sternite VII (Fig. 198) with small postero-median depression, this depression with denser setae directed diagonally postero-mediad, posterior margin weakly concave in the middle; sternite VIII transverse, posterior excision moderately deep and V-shaped; aedeagus (Figs 199–200) probably approximately 1.05 mm long (basal portion of aedeagus of the teneral holotype somewhat deformed); ventral process short and broad, with ventral portion of triangular and dorsal portion of semi-circular outline in ventral view; dorso-lateral apophyses short, strongly dilated in apical three fourths (ventral view), and somewhat extending beyond apex of ventral process.

Comparative notes. This species is characterized particularly by the conspicuously short elytra and by the distinctive shapes of the ventral process and of the dorso-lateral apophyses of the aedeagus. Closer affiliations to other species known from Yunnan are not evident.

Distribution and natural history. The type locality is situated in the Bangma Shan to the northwest of Lincang, Yunnan (Fig. 90). The specimens were sifted from leaf litter in a degraded forest at an altitude of 2210 m. The holotype is distinctly teneral.

Nazeris fissus sp. n. (Figs 90, 201–206)

Type material. Holotype ♂: "CHINA (Yunnan) Pu'er Pref., Ailao Shan, 37 km NW Jingdong, 24°45'12"N, 100°41'24.5"E, 2300 m (devastated forest remnant, litter, moss, grass roots sifted), 13.IX.2009 D.W. Wrase [48] / Holotypus ♂ *Nazeris fissus* sp. n. det. V. Assing 2013" (cAss). Paratypes: 7♂, 8♀ [partly teneral]: "CHINA: Yunnan, Pu'er Pref., Ailao Shan, 37 km NW Jingdong, 24°45'12"N, 100°41'24.5"E, 2300 m, devastated forest remnant, litter & dead wood sifted, 13.IX.2009, leg. M. Schülke [CH09-48]" (ZFMK, cSch, cAss); 1♂: "CHINA: Yunnan, Lincang/Dali Pref., Wuliang Shan, old pass road, N pass, 24°45'16.4"N, 100°29'50.3"E, 2350 m, forest litter & tea plantation, litter, mushrooms, grass sifted, 16.IX.2009, leg. M. Schülke [CH09-55]" (cAss).

Etymology. The specific epithet (Latin, adjective: split, divided) alludes to the conspicuously bifid ventral process of the aedeagus.

Description. Small and slender species; body length 4.5–5.5 mm; length of forebody 2.5–2.8 mm. Habitus as in Fig. 201. Coloration: forebody dark-reddish to dark-brown, with the pronotum usually slightly darker; abdomen blackish-brown; legs yellowish; antennae yellowish, with antennomere I slightly darker.

Head (Fig. 202) 1.05–1.08 times as long as broad; median dorsal portion indistinctly elevated; punctation coarse, dense, and umbilicate; interstices without microsculpture, forming narrow ridges; eyes moderately small, distinctly less than one third as long as the distance from posterior margin of eye to posterior constriction of head. Antenna approximately 1.5 mm long.

Pronotum (Fig. 202) 1.11–1.15 times as long as broad and 0.93–1.00 times as broad as head; punctures rather dense and non-umbilicate, nearly of similar diameter as those of head, but much deeper; interstices glossy; midline punctate in anterior half, impunctate and narrowly elevated in posterior half.

Elytra (Fig. 202) approximately 0.6 times as long as pronotum; humeral angles obsolete; punctation dense, somewhat less coarse than that of pronotum; interstices glossy. Hind wings completely reduced.

Abdomen approximately 1.2 times as broad as elytra; punctation dense and coarse on tergite III, gradually becoming less dense and less coarse towards tergite IV–VI, fine and sparse on tergites VII and VIII; interstices without microsculpture and glossy; posterior margin of tergite VII without palisade fringe; posterior margin of tergite VIII strongly convex.

♂: sternite VII (Fig. 203) unmodified, posterior margin truncate; sternite VIII (Fig. 204) as long as broad, posterior excision small and V-shaped, approximately 0.13 times as deep as the length of sternite VIII; aedeagus (Figs 205–206) 0.85–0.87 mm long and of highly distinctive morphology; ventral process completely divided into two lamellae; dorso-lateral apophyses almost straight and slender, at basal third with a distinct process directed mediad, not reaching apex of ventral process.

Comparative notes. *Nazeris fissus* is readily distinguished from other congeners known from Yunnan by the completely divided ventral process of the aedeagus, the shape of the dorso-lateral apophyses, from most species also by small body size in combination with brownish coloration of the forebody. Based on the synapomorphically derived

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morphology of the aedeagus (ventral process completely divided), this species is undoubtedly most closely related to *N. caoi* Hu et al., 2011 from the Nabanhe Nature Reserve.

Distribution and natural history. The species was recorded from two localities, the type locality in the Ailao Shan and one locality in the Wuliang Shan, Yunnan (Fig. 90). The specimens were sifted from litter in two forest habitats at altitudes of 2300 and 2350 m, on both occasions together with *N. sagittifer*. Some of the type specimens are teneral.

Unnamed and presumably undescribed species

Four species were represented in the examined material only by females:

Nazeris sp. 4: 1♀: "CHINA: Yunnan, Baoshan Pref., Gaoligong Shan, 78 km N Tengchong, 2000 m, 25°44'49"N, 98°33'29"E, cleft with creek and forest remnant, litter & dead wood sifted, 1.IX.2009, leg. M. Schülke [CH09-21]" (cSch).

Based on the external characters, this species is probably closely related to *N. curvus* and allied species of the *N. cangicus* group.

Nazeris sp. 5: 1♀: "CHINA: Yunnan prov., 1.3–2.0 km S of Haba, 17–20.VI.2007, Haba Xueshan Mts., 2830–3000 m, 27°22.1'N, 100°08.2'E, Hájek & Růžička leg." (cSch).

This species, too, probably belongs to the *N. cangicus* group.

Nazeris sp. 6: 2♀: "CHINA: Yunnan, Dali Bai Aut. Pref., Zhemo Shan, 7 km SW Xiaguan, 25°32-33'N, 100°10-11'E, 2870–2970 m, scrub with bamboo, oaks & Rhododendr., litter sifted, 18.IX.2009, leg. M. Schülke [CH09-60]" (cSch).

Based on the external characters, this species is closely related to *N. daliensis* and allied species. It is readily distinguished from the syntopic *N. zhemoicus* by a larger and more robust body, a less oblong head with a practically completely matt surface and less coarse punctation, and the denser punctation of the abdomen.

Nazeris sp. 7: 3♀: "CHINA: Yunnan, Dali Bai Aut. Pref., Mao Jiao Shan, E pass, 58 km NE Dali, 25°56'41"N, 100°40'05"E, 2525 m, second. mixed forest, litter, moss & mushrooms sifted, 4.IX.2009, leg. M. Schülke [CH09-26]" (cSch).

This species, too, is presumably closely related to *N. daliensis* and allied species, as is suggested by the similar external characters.

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Records of 'Indian' Baya Weaver *Ploceus philippinus philippinus* (Linnaeus, 1766) and Hooded Wheatear *Oenanthe monacha* (Temminck, 1825) from Afghanistan (Aves: Passeriformes)

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Abstract. Here we present the first record of Baya Weaver *Ploceus philippinus* for the country of Afghanistan. A specimen was collected on May 29, 1967 in the vicinity of Bari Kowt (بری کوټ) in the province of Kunar (کنړ). In addition, a Hooded Wheatear *Oenanthe monacha* was collected on January 17, 1968 in the vicinity of Farah (فراه) in southwestern Afghanistan. Hitherto the status of the species in Afghanistan is unclear. We describe both specimens and shortly discuss the records.

Keywords. Ploceidae, Muscicapidae, range extension

INTRODUCTION

Afghanistan is situated in a zoogeographic transition zone where Palearctic faunal elements meet those typical for the Oriental region. For a landlocked country, Afghanistan is extraordinary species-rich with about 490 bird species recorded so far (Habibi 2007; according to Lepage 2012: 491 species following taxonomy of IOC World Bird Names 2012). After decades of political instability, which hindered ornithological research, the birds of Afghanistan have received more attention only very recently. In particular the seminal work by Rasmussen & Anderton (2012) gives a comprehensive overview of the avifauna of the country. Otherwise, mainly single observations were published in the last years (e.g. Balmer & Murdoch 2010a, b, Harrison & Grieve 2012a, b, Kowatsch & Probst 2006, Mostafawi & Ostrowski 2010, Ostrowski et al. 2008a, b). However, in north-eastern Afghanistan a likely breeding population of one of the least known bird species on the globe, the Large-billed Reed-Warbler *Acrocephalus orinus*, was discovered only recently (Svensson 2008, Timmins et al. 2009, 2010), and breeding was confirmed right across the border in Tajikistan (Ayé et al. 2010).

The Zoological Research Museum Alexander Koenig (ZFMK) harbours a significant collection of birds from Afghanistan. Most of the specimens were collected during zoological and botanical expeditions as well as longtime stays from the mid-1960s until the beginning of the 1970s. The main collectors were G. and J. Niethammer, A. and H. Brade, C. M. Naumann as well as E. J. Kullmann. In addition, at least parts of the collection of the former Zoological Museum of Kabul are now held at the ZFMK. Some important results of the ornithological research at that time were contemporarily published (e.g. Niethammer 1967, Niethammer & Niethammer 1967, Niethammer 1973). However, the collection has never been completely inventoried, and this was only carried out within the last months. Herein, we present the first results of this task, namely the discovery of two species new for Afghanistan or at least with hitherto unproven status for the country.

RESULTS

Specimen of *Ploceus philippinus philippinus*

The specimen (ZFMK 2012.937) was collected on May 29, 1967 in east Afghanistan in the province Kunar (کنړ) in the vicinity of Bari Kowt (بری کوټ) (coordinates: 35.2992° N, 71.5397° E) within two kilometres from the Pakistan-Afghanistan border (original label: E-Afghanistan, Prov. Kunar-ha, vic. Barikot, 1300 m, Zoologisch. Museum Kabul/Afghanistan Nr. 942). There is no collector given, but according to the handwriting the bird was labelled by C. M. Naumann. However, (re)labelling could have happened belatedly as the species name was added subsequently. Thus, the collector remains unknown. The bird is a male of unknown age. It is perhaps not in complete breeding plumage, as the dark area of the head and throat is light brownish and yellow feather mar-

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Fig. 1. Ventral (a) and dorsal (b) view of the specimen of Baya Weaver *Ploceus philippinus* (ZFMK 2012.937) collected near Bari Kowt, Afghanistan, on May 29, 1967.

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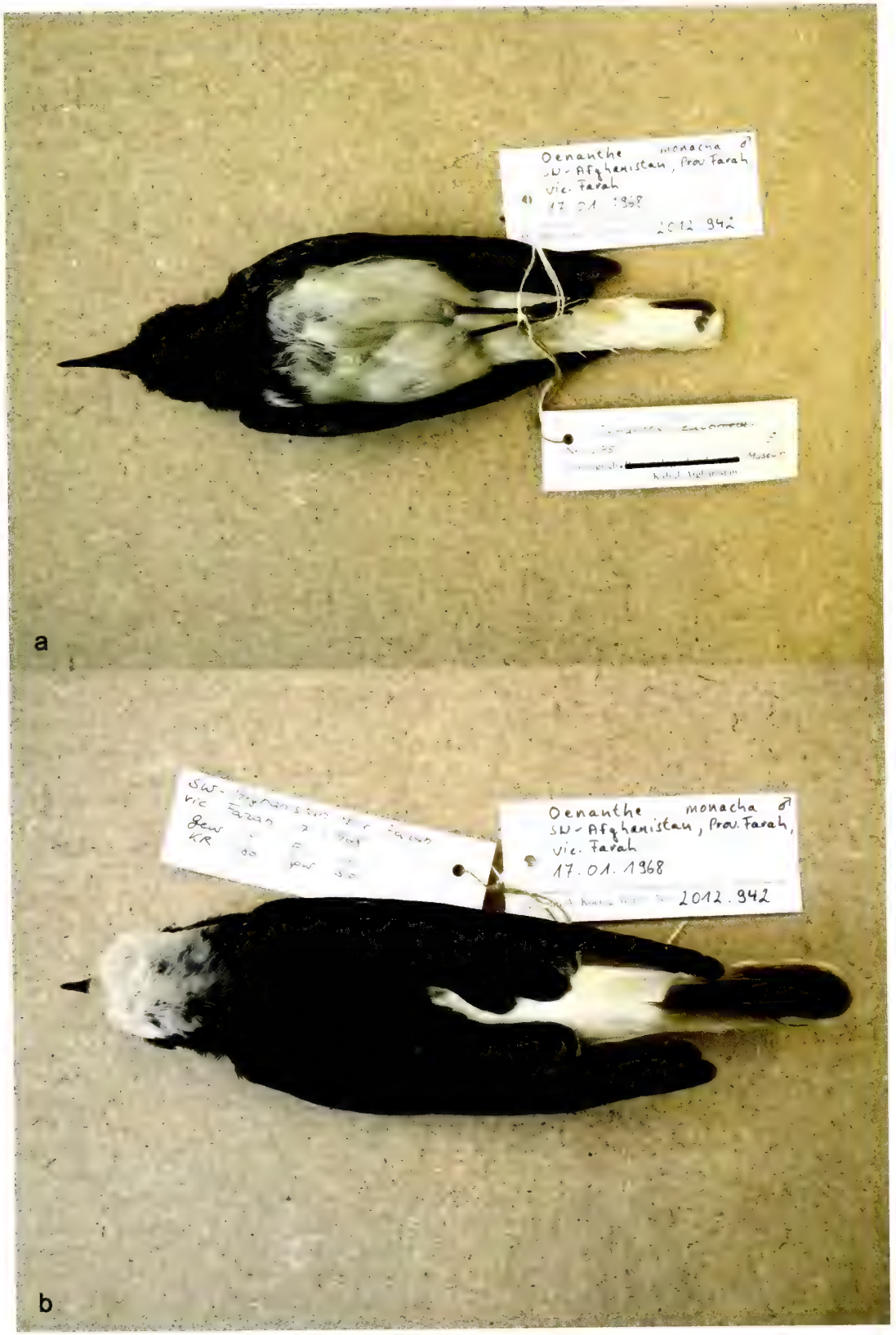

Fig. 2. Ventral (a) and dorsal (b) view of the specimen of Hooded Wheatear *Oenanthe monacha* (ZFMK 2012.942) collected in the vicinity of Farah, Afghanistan, on January 17, 1968.

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Table 1. Measurements of the specimen of *Ploceus philippinus philippinus*. Methodology follows Eck et al. (2011).

Body part	Size [mm]
Wing (flattened)	71
Tail	49
Bill length (tip to distal nostril)	11.7
Bill height (proximal nostril)	9.5

Table 2. Measurements of the specimen of *Oenanthe monacha*. Methodology follows Eck et al. (2011).

Body part	Size [mm]
Wing (flattened)	109
Tail	75
Bill length (tip to distal nostril)	11.9
Bill height (proximal nostril)	4.5

gins on the back are not outstanding prominent (Fig. 1). The head cap is yellow, partially with some fine darker shaft streaks. Mantle feathers are centrally brown with obvious yellow margins. Tail and wings are dark brown with lighter margins. On the tertials, margins of the outer vanes are buffy to rusty while they are yellow-olive on the secondaries forming an unobtrusive wing panel. The throat is light brown, the breast yellow and the belly is light yellowish to whitish while the flanks are rather buffy. In addition, tarsi and toes are horn-coloured. The bill of the specimen is largely black with small lighter areas at the basis of the upper and lower mandible. Note that some colour fading cannot be excluded for darker feathers and bare parts. Nevertheless, identification as *Ploceus philippinus* is straightforward given the limited number of possible confounding species in southern Asia. In contrast to *P. benghalensis* and *P. manyar*, the yellow breast is striking, and this also allows identification as belonging to the nominate subspecies. The occurrence of the rather similar subspecies *P. p. travancoreensis* would be highly unlikely, as this taxon is limited to south-western India. The three outer primaries on both wings are heavily abraded and faded while the inner primaries are fresh. Nevertheless, measurements are within the known range of the species (Table 1, see Rasmussen & Anderton 2012). For unknown reasons, wing measurement given on the original label exceeds our measurement by 9 mm.

Specimen of *Oenanthe monacha*

The specimen (ZFMK 2012.942) was collected on January 17, 1968 in south-western Afghanistan in the vicinity of the city of Farah (coordinates: 32.3744° N, 62.1164° E) in the province of the same name (original label: SW-Afghanistan, Prov. Farah, vic. Farah, Zoologisch. Museum Kabul/Afghanistan Nr. 1075). The specimen was also once held in the collection of the former museum of Kabul. As for the weaver, no collector is given on the label. However, specimens collected between Delaram and Farah on January 16, 1968 and on January 22, 1968 between Djuwein and Farah were collected by Heinrich Klockenhoff. Thus, he is almost certainly the collector of the *Oenanthe monacha* specimen as well as of four additional specimens from the same day and location (species: *Lanius excubitor pallidirostris*, *Cettia cetti*, *Phoenicurus erythronotus*, *Phoenicurus ochruros*).

Species identification is easy. The pure size (Table 2) excludes the smaller *Oenanthe* species, and the bird is readily identifiable as a male. In contrast to *Oenanthe albonigra*, the whitish head cap is striking (Fig. 2). Mantle and wings are black, upper tail coverts, rump and lower back are white. The black of chin and throat extends to the upper breast. The belly and under tail coverts are white with a buffy tinge. Also note that the specimen does not show a complete terminal dark tail bar as would be the case in *Oenanthe picata capistrata*. Whitish tips to breast and throat feathers as well as on the mantle and on the remiges indicate a relatively fresh plumage. As there is no obvious moult limit in the greater coverts detectable, it is most likely an adult (van Duivendijk 2010). Bare parts are black. *Oenanthe monacha* is monotypic (Dickinson 2003).

DISCUSSION

We presented two ornithological records for Afghanistan. Concerning the specimen of *Ploceus philippinus*, one can only speculate if the incongruence on the label is due to transcription errors or even some kind of mislabelling, as field labels do not exist. Unfortunately, there is no hint for distinct collection activities at the finding locality, since no other specimen from the same location or from the same time can be found within our collection. Thus, the collection history of the specimen cannot be retraced. Due to its bright plumage and its ability to perform tricks, *Ploceus philippinus* is frequently caught and sold as cage bird in Pakistan (Roberts 1992). Furthermore, the bird market of Kabul still reflects the Afghan tradition of keeping pet birds, as captured wild birds from throughout Afghanistan as well as from Pakistan and India are sold here (Ostrows-

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ki 2007). A record of *Ploceus philippinus* on the bird market could not be provided, though (Ostrowski 2007). The abraded primaries could also be a hint to a captive origin although, alternatively, they might have been heavily worn out naturally. Therefore, it is impossible to completely rule out the possibility that the record represents an escaped bird. On the other hand, date and location of the presented record make perfectly sense. *Ploceus philippinus* is the most widespread species of Ploceidae in southern Asia. It inhabits a wide range of habitats including grasslands and cultivated areas mostly close to water, although it is less bound to swamps than other weavers in the region (Craig 2010). In Pakistan, the species can be "locally abundant" in the Indus basin (Grimmett et al. 2008). Bari Kowt is also located within the Indus basin, as the town is situated at the shore of the Kuna River, a tributary of the Kabul River, which eventually feeds the Indus. Collected at an altitude of 1300 m a.s.l., the bird occurred near the upper limit of its altitudinal distribution which reaches 1400 m a.s.l. at the Himalayan foothills (Craig 2010). According to the map in Grimmet et al. (2008, p. 224), the next known natural occurrence in Pakistan might be about 100 km away. Thus, habitat as well as the location of the discovery fit well in the general ecology and the biogeographical pattern of the distribution of the species. *Ploceus philippinus* is generally assumed to be sedentary (Rasmussen & Anderton 2012), but at least in Pakistan it widely disperses in non-breeding seasons (Grimmet et al. 2008). We do not know whether the record presented here only indicates a vagrant or whether the specimen even represents a breeding population. At least the collection date fits perfectly within the regional breeding season of the species (Roberts 1992). We recommend adding *Ploceus philippinus* at least tentatively to the Afghan avifauna. To our knowledge there is no other record of the species from the country. It is not mentioned by Paludan (1959) or Ayé et al. (2012), and the map in Rasmussen & Anderton (2012) does not indicate any occurrences.

Oenanthe monacha is patchily distributed from Egypt throughout the Middle East to southern Pakistan (Collar 2010). In most places, it seems to be only a sparse breeding resident in remote habitats like desert ravines and wadis up to 1300 m a.s.l. although it might also occur in the vicinity of buildings in the desert (Collar 2010, Porter & Aspinall 2010). Habitats are often too barren and arid for other *Oenanthe* species (Collar 2010). In addition, the species is described as shy and unobtrusive (Svensson 2009). Nearest depicted occurrence is eastern Iran where the Lut desert (Dasht-e-Lut) reaches close to the Afghan border (see map in Porter & Aspinall 2010, p. 314). However, there is at least one unproven sight report from Puli Chakri which even suggests breeding (Kullberg 2002) and this observation was cited by Habibi (2007). Nevertheless, neither Paludan (1959) nor Ayé et al. (2012) mention *Oenanthe monacha,* and the map in Rasmussen & Anderton (2012) does not denote any findings from Afghanistan. Thus, the status of the species in the country was hitherto categorised as unconfirmed (UNEP 2008).

In conclusion, our findings add to the still fragmentary knowledge of the Afghan avifauna. The presented records of a Palaearctic and an Oriental faunal element further highlight the transitional character of the fauna of Afghanistan.

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Small mammal community composition in the Volcanoes National Park, Rwanda

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Abstract. Terrestrial small mammal community composition was examined in the Volcanoes National Park (VNP), Rwanda with respect to variation in habitat type and altitude. Trapping resulted in the capture of 220 individuals including eight species of rodents, three species of shrews and one mongoose. Of the species captured, *Praomys degraaffi* is vulnerable and *Sylvisorex vulcanorum* is near threatened (IUCN 2012). Six species (*Hylomyscus vulcanorum, Mus bufo, Praomys degraaffi, Sylvisorex vulcanorum, Lophuromys woosnami* and *Tachyoryctes ruandae*) are endemic to the Albertine Rift. Species richness and diversity varied significantly among the different habitat types as they increased with elevation up to the middle altitudes (2860–3255m) and then declined with increasing elevation. Altitude accounted for 20 % of the variation in species diversity. Species variation in habitats and altitude was related to environmental factors. Endemic species were found mainly in low and middle attitude habitats; thus these habitat types are important for conservation of small mammals at Volcanoes National Park.

Key words. Rodentia, Soricidae, Volcanoes National Park, endemism, diversity, elevational gradient, community structure.

INTRODUCTION

Baseline data are essential for biodiversity monitoring, especially during this era of anthropogenic and climatic change. However, the lack of accurate data on the status of free-ranging wildlife populations may limit the efficacy of monitoring programs. The African montane primary forests of the Albertine Rift are home to many endemic mammal species (Hutterer et al. 1987; Kerbis Peterhans et al. 1998; Kaleme et al. 2007). The Volcanoes National Park, gazetted as Parc National des Volcans in 1925 (hereafter VNP) is an afromontane forest rich in mammal species and endemism and is continuous with adjacent volcanoes in the Democratic Republic of Congo and Uganda. Many small mammals exhibit narrow habitat preferences and the distribution and abundance of small mammals may be indicators of ecosystem health (Golley et al. 1975). Habitats with low vegetation diversity house relatively few species (Kaleme et al. 2007), and altitudinal variation also influences small mammal diversity (Kerbis Peterhans et al. 1998).

The VNP is thought to support more than 25 small mammal species (Gyldenstolpe 1928; Hutterer et al. 1987). However, few studies on the ecology and community characteristics of small mammals (rodents and shrews) have been done in the VNP region (Gyldenstolpe 1928; Hutterer et al. 1987). While a considerable amount of work has been carried out on the vegetation, birds and large mammals of VNP, including the critically endangered *Gorilla beringei beringei* Matschie, 1914 (Plumptre 1991; Fischer & Hinkel 1992; Robbins et al. 2001; Owiunji et al. 2005), small mammals remain poorly documented. The only scientific publication on small mammals in the VNP was written over 80 years ago (Gyldenstolpe 1928) when 20 species were noted (data included in Table 1), but detailed small mammal diversity and distribution patterns were not determined. Since then, there has only been one unpublished study by Kajonjoli in 1993, rendered incomplete by 1990's Rwandan civil war and the unpublished report (data included in Table 1) on the Ugandan slope of Mgahinga Gorilla National Park (MGNP) by Kerbis Peterhans & Austin (1996).

Information on small mammal distribution and abundance across diverse habitats and along an elevational gradient in VNP will be useful to supplement additional scientific data for understanding structure and variation of small mammal communities. In this paper, we document small mammal community characteristics at VNP based on our recent collecting program, and specifically (1) compare small mammal abundance, diversity and distribution in eight habitats (Bamboo, *Hagenia* Woodland, Brush Ridge, Mixed Forest, Herbaceous, Sub Alpine, Alpine

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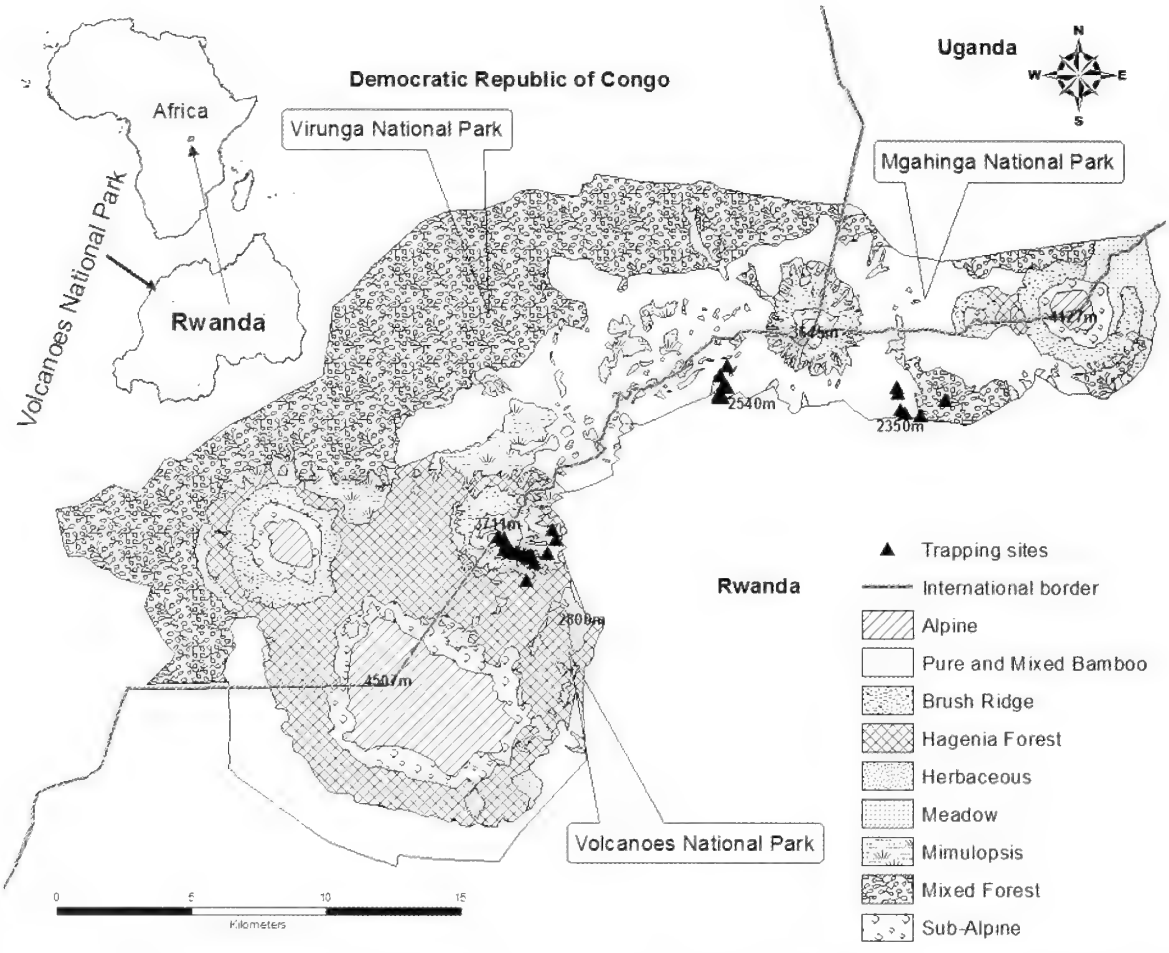

Fig. 1. A map of the Virunga massif illustrating the major vegetation zones and the locations of the trapping sites in the VNP.

zones, and Swamp); (2) assess levels of diversity in relation to altitude, environmental variables and habitat characteristics. (3) Finally, we provide data from two previous studies that contribute to assessing changes in Virunga small mammal diversity and abundance over the past.

MATERIAL AND METHODS

The study area

The Volcanoes National Park, Rwanda (between 1°21'–1°35'S, 29°22'–29°44'E) is a mountainous region, ranging in altitude from 2300 m to 4500 m (Weber 1987). It is located on the eastern edge of the Albertine Rift, which forms part of the watershed between the Nile and Congo River systems (Weber 1987). It lies in north-western Rwanda and borders its sister parks, the Virunga National Park (ViNP) in the Democratic Republic of the Congo (DRC) and Mgahinga National Park (MGNP) in Uganda. The Volcanoes National Park (VNP), ViNP and MGNP (Fig. 1) form the Virunga volcanoes area (Virunga massif). This study was carried out at three sites in the Volcanoes National Park, Rwanda (Mts. Visoke or Bisoke, Sabyinyo or Sabinio and Gahinga) from October 2 to November 8, 2009. The selection of study sites was based on altitude and the major vegetation zones of VNP (Fig. 1). The major vegetation zones surveyed include: (1) Mixed Forest, (2) Bamboo, (3) *Hagenia* Woodland, (4) Herbaceous, (5) Brush Ridge, (6) Sub Alpine zone, and (7) Alpine (Plumptre 1991); swamps were categorized as an 8th zone.

For Table 1, we add data from two historical collections. The first reflects the efforts of the Swedish Zoological Expedition to the 'Birunga Volcanoes' from February to March, 1921 (Gyldenstolpe 1928). The second collection includes the species records from a more recent report (Kerbis Peterhans & Austin 1996) that gathered baseline data on terrestrial small mammal communities surrounding Kabiranyuma Swamp on the saddle between Muhavura and Mgahinga (2980 m) as well as land reclaimed for the park (2810 m) from evicted settlers, just on the Ugan-

Table 1. Small mammal species recorded in the Virunga massif then and now. Area codes: Burunga (B), Chahafi (Ch), Karisimbi (Ka), Kibati (Ki), Lulenga (L), Lake Mutanda (LM), Mgahinga (Mg), Muhavura (Mu), Mikeno (Mi), Ninagongo (Ni), Ngoma (Ng), Sabinio(Sa), Tamohanga (Ta), Tsitsilonga (Ts), Visoke (Vi). References (Ref.): (1) Gyldenstolpe (1928); (2) Kerbis Peterhans & Austin (1996); (3) this study.

Species	Elevations	Mtn (area)	Ref.
Crocidura niobe Thomas, 1906	2980	Mg-Mu	2
Crocidura olivieri kivu Osgood, 1910	up to 3300	B,Ki, Lu,Mi,Ta	1
	2810	Mg	2
	up to 3700	Vi	3
Crocidura tarella Dollman, 1915	2900	LM	1
		Vi	3
Paracrocidura maxima Heim de Balsac, 1959	2810	Mg	2
Suncus megalura (Jentink, 1888)	2810, 2980	Mg, Mg-Mu	2
Sylvisorex lunaris ruandae Lönnberg & Gyldenstolpe, 1925	2600	Sa	1
	2810, 2980	Mg, Mg-Mu	2
Sylvisorex vulcanorum Hutterer & Verheyen, 1985	2810, 2980	Mg, Mg-Mu	2
	2980	Vi	3
Myosorex babaulti Heim de Balsac & Lamotte, 1956	2980	Mg-Mu	2
Heterohyrax helgei Lönnberg & Gyldenstolpe, 1925	3500–4000	Mi, Sa	1
Hystrix stegmanni Muller, 1910		Mu,Sa	1
Aethosciurus ruwenzorii vulcanius Thomas, 1909		Mi- Ni	1
Funisciurus carruthersi birungensis Gyldenstolpe, 1927		Mi,Ki	1
Tamsicus vulcanorum vulcanorum Thomas, 1918		Mi	1
Graphiurus murinus vulcanicus Lönnberg & Gyldenstolpe 1925	3900	Ki	1
	2810	Mg	2
	2500–3000	Sa, Vi	3
Delanymys brooksi Hayman, 1962	2980	Mg-Mu	2
Dendromus c.f. *insignis kivu* Thomas, 1916	2980	Mu	1
		Mg-Mu	2
Lophuromys aquilus laticeps Thomas & Wroughton, 1907	up to 4000	B,Ka, Ki,LC, LM, L,Mi,	1
	2810, 2980	Mu,Ng, Sa,Mg,	2
	2400–3700	Mg-Mu Vi, Sa	3
Lophuromys woosnami Thomas, 1906	2810, 2980	L, Mi, Ki, Mu,	1
	2400–3600	Sa,Mg, Mg-Mu	2
		Vi, Sa	3
Arvicanthis abyssinicus rubescens Wroughton, 1909		LC	1
Dasymys incomtus medius Thomas, 1906	up to 2600	B, L, Sa,Ta	1
Dasymys c.f. *rwandae*	2810, 2980	Mg, Mg-Mu	2
Grammomys c.f. *dolichurus*	2810	Mg	2
Hylomyscus aeta weileri Lönnberg & Gyldenstolpe, 1925	2400	Mi	1
Hylomyscus vulcanorum Lönnberg & Gyldenstolpe, 1925	3700–3800	Ki, Mi	1
	2810, 2980	Mg, Mg-Mu	2
	2400–3400	Vi,Sa	3
Lemniscomys striatus cf. *massaicus* (Pagenstecher, 1885)		L	1
Mus bufo bufo Thomas, 1906	2700	B, Sa	1
	2810	Mg	2
	2540, 2850	Sa, Vi	3
Mus gratus gratus Thomas & Wroughton, 1910		Ni	1
Mus triton birungensis Lönnberg & Gyldenstolpe, 1925	3400	Mi	1
	2980	Mg-Mu	2
Oenomys hypoxanthus (Pucheran, 1855)			1
	2810, 2980	Mg, Mg-Mu	2
	2820	Vi	3
Praomys degraaffi Van der Straeten & Kerbis Peterhans, 1999	2810	Mg	2
	3220	Vi	3
Praomys jacksoni montis Thomas & Wroughton, 1910		Sa,Ki,LM	1
Thamnomys kempi Dollman, 1911	3900	Ki	1
	2810, 2980	Mg, Mg-Mu	2
Otomys denti kempi Dollman, 1915	2800–3400	B,Mu,Sa,Ki	1
	2810, 2980	Mg, Mg-Mu	2
Otomys tropicalis vulcanicus Lönnberg & Gyldenstolpe, 1925	2980	Sa	1
		Mg-Mu	2
Tachyoryctes ruandae Lönnberg & Gyldenstolpe, 1925		L, LC,Mu	1
	2810	Mg	2
	2700	Vi	3

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da side of the Virunga Volcanos (Mgahinga Gorilla National Park). Authors of taxon names of small mammals are included in Table 1 or may be found in Wilson & Reeder (2005).

Field methods

Both live and snap traps were used. The live traps were large Sherman folding traps (3"x3"x10"), and small, non-folding perforated traps (2"x 2 ½"5 x 6- ½"). Both Live and Sherman traps were laid out in lines, 10 m apart (Tews et al. 2004), with five lines located randomly in each habitat at least 100 m away from human paths (Sutherland 2008). Snap traps were placed at the same points as live traps. Each trap was set for three nights. All traps were baited with crushed ground-nuts, meat and fish, bananas, and pieces of potatoes. They were checked daily between 0700h and 1000h and again between 1400h and 1600h. A locally made trap was used to collect mole rats (*Tachyoryctes ruandae*) in private cultivated plots adjacent to the park.

At each station, trapped animals were collected, processed and/or released (Nicolas & Colyn 2006). Live animals were placed in a zip-lock plastic bag and weighed using either 100 g or 500 g Pesola spring balances. A field identification was provided, sex determined and various measurements taken (head-body length, tail length, ear length, and hind foot length) using a ruler graded in mm. Each newly captured animal to be released was marked by fur-clipping to ensure it could be recognized if subsequently recaptured.

Within each of the habitat types, the major plant species were recorded from the grids as follows: herbaceous zones used $2m^2$ plots; shrub areas used $5m^2$ plots; areas dominated by trees used $10m^2$ plots. Plant species were identified from herbarium material at Karisoke Research Center (KRC) and from the Flora of Rwanda (Troupin 1977–1988).Temperature and wind speed were collected daily between 9:00–9:30 am, allowing comparison between different sites.

Data analysis

To standardize data for all habitats sampled so that species richness and diversity could be compared, trap success for each trapline (the number of animals caught per 100 trap nights) was calculated. The number of species trapped (per 100 trap nights) was also calculated for each site using the expression: [Species richness/Trap effort] x 100. The Shannon-Wiener (H) index of diversity was calculated for all sites sampled and evenness values were derived from it.

$$H = \sum -(P_i * \ln P_i)$$

with H = the Shannon diversity index; P_i = fraction of the entire population made up of species I; S = numbers of species encountered; and $\sum$ = sum from species 1 to species S. The Shannon index increases with the number of species in a community, and in theory, the Shannon index cannot exceed 5.0 (Krebs 1989). A high value of Shannon-Wiener index may indicate a large number for the species with similar abundances; a low value indicates lower species richness or domination by a few species. Evenness values (E)[E = H / ln (S)] indicate how numbers of individuals are distributed among species in a community. When the evenness is high, the mammal fauna is more diverse and the species are equally abundant (Magurran 2005).

We tested non-parametric estimators available in EstimateS software (available at http://viceroy.eeb.uconn.edu /estimates/EstimateS) to estimate species richness as an alternative to the observed number of species in model Chao1. The classic richness estimators Chao1 was computed along with log-linear 95 % confidence intervals (Chao 2005, Colwell & Coddington 1994).

In order to estimate the number of additional species necessary to reach an asymptotic plateau, species accumulation rates were examined and were compared among each habitat type (Colwell et al. 2004). The calculation of species accumulation rates and the estimation of asymptotes/plateaux (species richness) were derived from the distribution of all individuals caught across habitats; species richness was estimated as a function of number of samples. If the curves became flatter with increasing effort (Chao 1 confidence bounds met or connected), it becomes less likely to detect new species in the additional samples.

Similarities of the small mammal communities in the different habitats were assessed using Bray-Curtis similarity indices and linked Cluster Analysis. Tukey's Honestly-Significant-Difference (Tukey HSD) tests were used for post-hoc comparisons when significant among-groups differences were indicated. To investigate the relationship between small mammal species and environmental factors, a Canonical Correspondence Analysis (CCA) was used. This is an indirect gradient analysis technique used to study the distribution of species along easily measured, recognizable environmental variables (Gauch & Whittaker 1972). The mole rat *Tachyoryctes ruandae* was found in cultivated fields outside the park, and it was not included in statistical analyses.

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Table 2. Total numbers of individuals per species captured in the eight habitat types at VNP.

Species /Habitat/Altitude (m)	Mixed Forest	Swamp	Bamboo	*Hagenia* Woodland	Herbaceous	Brush Ridge	Sub Alpine	Alpine	Total
	2380–2580	2540	2540–2660	2740–3020	2900–3183	3220–3400	3420–3600	3640–3710	
Crocidura tarella					1				1
Crocidura olivieri	3			1	2	1		2	9
Galerella sanguinea						1			1
Graphiurus murinus	2	1		3					6
Hylomyscus vulcanorum	1	1	2	3	7	2	3		19
Lophuromys aquilus	8	15	4	8	24	15	15	10	99
Lophuromys woosnami	10	7	11	11	13	21	5		78
Mus bufo			1	1					2
Oenomys hypoxanthus				1					1
Praomys degraaffi						1			1
Sylvisorex vulcanorum				1					1
Tachyoryctes ruandae									(2)
TOTALS	**24**	**24**	**18**	**29**	**47**	**41**	**23**	**12**	**218**
Trap nights	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**300**	**2400**
Density (Trap success %)	**8.0**	**8.0**	**6.0**	**9.7**	**15.7**	**13.7**	**7.7**	**4.0**	**9.1**
# species	**5**	**4**	**4**	**8**	**5**	**6**	**3**	**2**	**12**

RESULTS

Species richness

Small mammal trapping resulted in the capture of 220 individuals (208 rodents, 11 shrews, and one mongoose). Ninety-nine individuals were female while 121 were male. A total of eight rodent species, three shrews and one mongoose species were recorded. All rodents caught belonged to the subfamilies Murinae, Deomyinae, Rhizomyinae and Graphiurinae (Wilson & Reeder 2005). The most common species were *Lophuromys aquilus* (n=99) and *Lophuromys woosnami* (n=78), combining for 80.54 % of the individuals captured. These species were encountered in all habitats; all other species were rare (≤19.46 % of individuals captured in all habitats).

Small mammal species diversity was highest in *Hagenia* Woodland (8), intermediate in Brush Ridge (6), Herbaceous and Mixed Forest (5), Swamp and Bamboo (4) and lowest in Sub Alpine (3) and Alpine (2). Rodent captures were always more numerous than shrew captures (Table 2).

For Sub Alpine and Alpine zone Chao1 species richness estimator upper bounds reached horizontal plateaux (asymptotes), and its upper bound reached the lower bound for the bamboo and mixed forest (Fig. 2), so sampling effort can be considered adequate to reflect actual species richness. In other habitats, plateaux were not attained. Furthermore, species accumulation rates for habitat types and altitudinal range showed that the most species rich habitats in VNP were mid elevation habitats: *Hagenia* Woodland followed by Brush Ridge and Herbaceous.

Species diversity between habitats

A Bray-Curtis dendrogram based on all individuals captured showed that two species captured in Alpine represented distinct communities than those from other habitats. The Alpine (highest elevation at over 3600 m) and Bamboo habitats (lowest elevations of 2540–2660 m) had the least similar mammal communities (26.66 %) and species richness was low in both zones.

The effective number of species (Shannon diversity) was highest (H>1.0) in *Hagenia* Woodlands and Brush Ridge, intermediate (0.8>H<0.6) in Herbaceous, Mixed Forest, Bamboo and Swamp and lowest in the Sub Alpine (H=0.2) and Alpine habitats (H=0.1). These differences in diversity indices were significant (Kruskal-Wallis test: $H_{7,\ 40}$=20.49; p=0.005). The variation in community species (Evenness) also differed significantly among habitats types (Kruskal-Wallis test: $H_{7,\ 40}$=20.49; p=0.005). The variation in community species were generally low (<0.5), indicating that communities in all habitats were dominated by two species (*Lophuromys aquilus* and *Lophuromys woosnami)*. Species diversity was negatively correlated with altitude. Altitude accounted for 20 % of the variation in species diversity with increasing altitude (p=0.004).

Environmental correlates of community structures

The CCA-biplot (the first two axes) for environmental variables, habitat and small mammal abundances ex-

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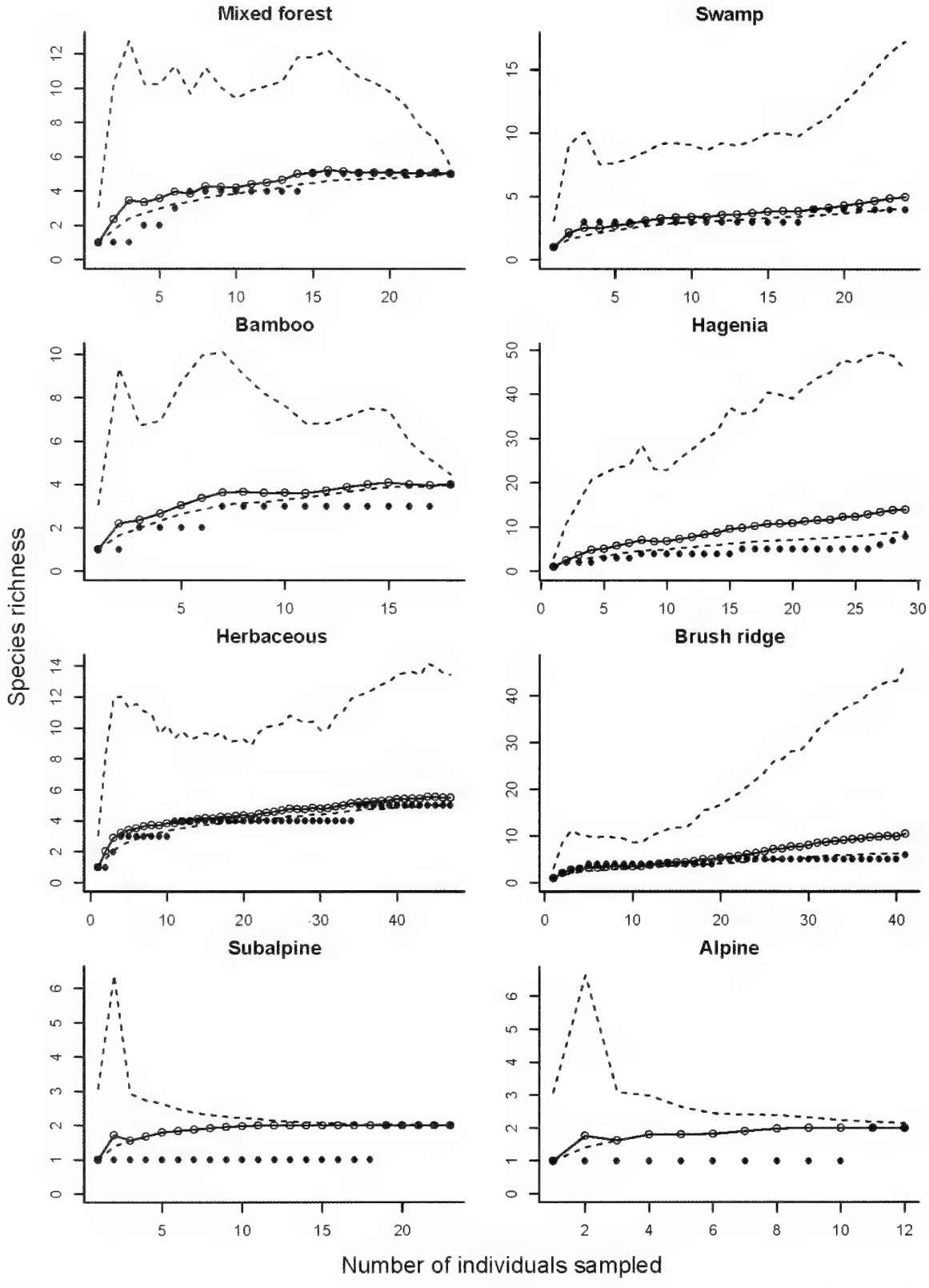

Fig. 2. Accumulation rates of observed and estimated (Chao1) richness. The black dots are observed number of species, the round circle represented Chao1 estimate, while dotted line is 95% confidence interval.

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plained 19.3+39.4 (equals to 58.7 %) of variance in the data set (Fig. 3). The environmental variables that affected separation of sites and species along axis 1 most strongly were temperature, altitude, canopy cover, herbaceous cover and wind speed.

Lophuromys aquilus, Lophuromys woosnami and *Hylomyscus vulcanorum* plotted near the intersection of the axes, suggesting that these species are not strongly influenced by any of the six environmental variables and that they are habitat generalists. Furthermore, *Crocidura olivieri kivu* also seemed to be a generalist, and occurred in five habitat types. The percentage of canopy cover has a greater influence on the distribution of *Graphiurus murinus vulcanicus*, a primarily arboreal species.

DISCUSSION

Our study found few small mammal species at VNP compared to previous studies. The contiguous forest at Mgahinga National Park has 16 known rodent species and seven shrew species (Kerbis Peterhans & Austin 1996), eight of which were recorded during this study: *Hylomyscus vulcanorum; Lophuromys aquilus; Lophuromys woosnami; Oenomys hypoxanthus*; *Sylvisorex vulcanorum; Crocidura olivieri; Graphiurus murinus* and *Mus bufo*. Differences in size of the protected areas, trapping techniques, time of year, elevation, and habitats sampled may account for differences in species diversity with this adjacent site. The differences between sizes of sampled areas and trapping methods might have influenced differences. For instance squirrels can be obtained using shotguns. Shrews are more easily captured with pitfalls. Gyldenstolpe (1928) covered the whole Volcanoes National Park, while this study has focussed on Mt Bisoke and the foot of Mt Sabyinyo.

Our study confirms a pattern of variation in species richness of small mammal communities along an altitudinal gradient. Habitat heterogeneity and altitudinal variations are a major factor affecting small mammal diversity (Isabirye-Basuta & Kasenene 1987; Stanley & Hutterer 2007). Mid elevation peaks in species diversity are common in both rodents and shrews whereas increasing elevation leads to fewer species. *Lophuromys aquilus* and *Lophuromys wosnami* are adaptable to the VNP habitats because they require moist scrub, forest, grassy, and tropical moist montane areas (Kingdon 1984). The elevational diversity might be related to climatic impacted factors such as rainfall, temperature, productivity, competition, resource abundance, habitat complexity, or habitat diversity (Lomolino 2001).

Species accumulation curves show insufficient sampling effort in six of eight studied habitats. Further, extreme weather during our sampling periods may have reduced trapping success. Some species previously collected in VNP were not captured during this study including *Crocidura niobe*, *Suncus megalura*, *Sylvisorex lunaris ruandae*, *Paracrocidura maxima*, *Myosorex babaulti* and eleven mice/rat species including *Delanymys brooksi, Dendromus insignis kivu*, *Dasymys incomptus*, *Dasymys*

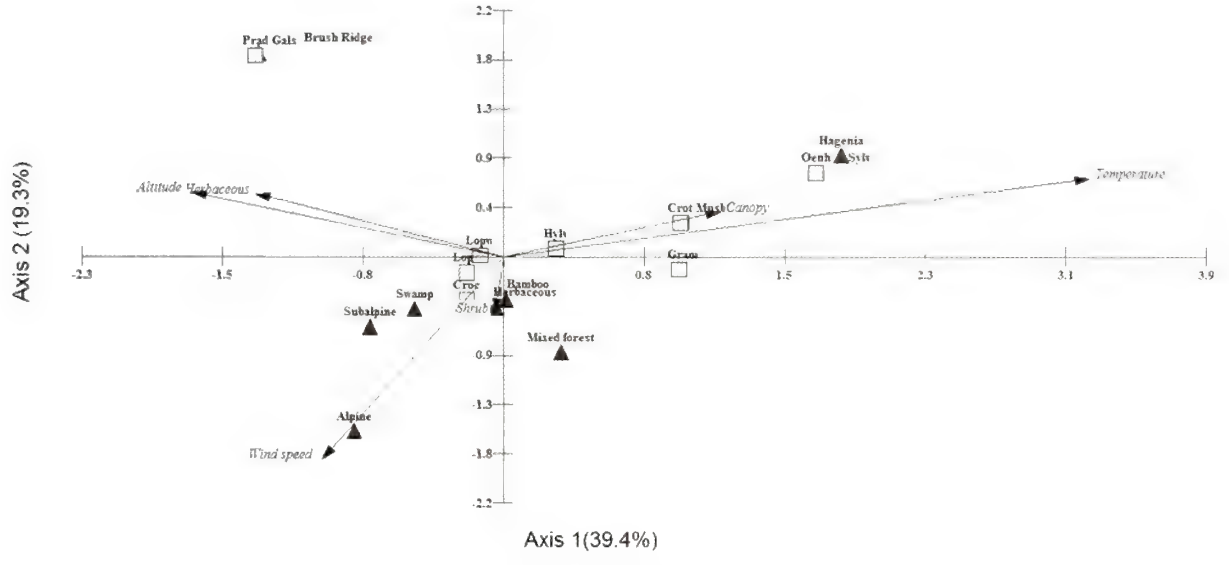

Fig. 3. CCA-biplot showing the influence of various environmental variables on small mammal distributions during this study period. Gram: *Graphiurus murinus*; Crot; *Crocidura tarella*; Croc: *Crocidura olivieri*; Hylv: *Hylomyscus vulcanorum*; Lapq: *Lophuromys aquilus*; Lopw: *Lophuromys woosnami*; Musb: *Mus bufo*; Oenh: *Oenomys hypoxanthus*; Prad: *Praomys degraaffi*; Sylv: *Sylvisorex vulcanorum*; Gals: *Galerella sanguinea.*

c.f. *rwandae*, *Grammomys* c.f. *dolichurus*, *Hylomyscus aeta*, *Thamnomys kempi*, *Otomys denti kempi*, *Otomys tropicalis vulcanus*, *Mus triton, Mus gratus* (Gyldenstolpe 1928; Hutterer et al. 1987; Kerbis Peterhans & Austin 1996). More trapping over different seasons and with the added use of pitfall traps in more habitats are needed to adequately document small mammal communities at VNP.

The study area contains relatively few endemic species (six) compared with other Albertine Rift sites. This compares with twenty-one endemic species in the Ruwenzori Mountains of Uganda (Kerbis Peterhans et al. 1998), and 18 endemic species in Kahuzi-Biega forest (Kaleme et al. 2007). Five of the six endemic species and the one threatened species were found at low and middle altitudes at VNP.

Species from VNP have a high probability of survival owing to international and governmental protection efforts directed at the mountain gorilla (*Gorilla beringei beringei*), an 'umbrella species' from a conservation perspective. Since gorillas and endemic rodents and shrews depend on the same habitats, the conservation of the first acts to ensure the conservation of the second. In order to maximize the maintenance of biodiversity conservation in general and small mammals in particular, conservation efforts need to target both low elevation and mid elevation zones at VNP.

Our results have implications for how small mammal communities in VNP may alter with climate change. With increasing temperature, formerly low-elevation small mammal species may expand their ranges upwards while those of high-elevation species may contract, leading to changed community composition at mid- and high elevations (Moritz et al. 2008). More long-term monitoring is desirable to incorporate these factors, and to examine in detail how to mitigate these risks.

Our study indicates that the small mammal species have changed much since the pioneer study of Gyldenstolpe (1928). This may be a signal of concern for the conservation of this forest, and stresses the importance of regular small mammal surveys with close attention to associated habitats.

The problem of spatial scales is also important; 40 trap lines located at three study areas may not have been sufficient in a protected area of 150 km^2 and 40 km of width. Long-term studies are needed to better understand the effects of climatic events relative to those of local differences related to habitat structure. The findings of species accumulation rates and comparatively low richness during this study indicate that the small mammal species list for VNP is still incomplete and further inventory work is needed. We recommend that future, longer-term studies are carried out to confirm our species list, and to examine demographic processes and the impact of climatic changes on gorilla habitat.

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Bats (Chiroptera) from the Albertine Rift, eastern Democratic Republic of Congo, with the description of two new species of the *Rhinolophus maclaudi* group

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Abstract. Horseshoe bats of the *Rhinolophus maclaudi* species group were recently revised by Fahr et al. (2002). Known members of the group are located in the mountainous region of West Africa and the Albertine Rift, east of the Congo River basin with a major gap (4300 km) between the two recognized sub-groups. Here we describe two additional species within this species group from the Albertine Rift center of endemism in the eastern Democratic Republic of Congo. One derives from the Misotschi-Kabogo highlands, a heretofore poorly documented region half-way down the western shore of Lake Tanganyika. Additional bat records from this locality are also documented. The second new taxon was collected in Kahuzi-Biega National Park, a World Heritage Site adjacent to the shore of Lake Kivu.

Key words. Rhinolophidae, endemism, new species, Misotschi-Kabogo highlands, Kahuzi-Biega National Park, Albertine Rift, Democratic Republic of Congo.

Résumé. Les espèces de chauve-souris appartenant au groupe de *Rhinolophus maclaudi* étaient récemment révises par Fahr et al. (2002). Les membres connus du groupe sont localisés du côté opposée au basin du Congo avec un vide de 4300 km entre les deux sous-groupes. Nous décrivons deux espèces appartenant au même groupe en provenance de l'est de la République Démocratique du Congo dans le Rift Albertin. L'une dérive des monts Misotschi-Kabogo, un site très mal connu pour sa biodiversité, situé a mi-chemin dans le versant ouest du lac Tanganyika. Les autres chauve-souris de la même région sont aussi documentées. L'autre espèce était collectée au Parc National de Kahuzi-Biega, un site du patrimoine mondial de l'UNESCO bien étudié, adjacent dans le versant ouest du lac Kivu.

Mots clés. Rhinolophidae, endémisme, espèces nouvelles, Misotschi-Kabogo, Kahuzi-Biega NP, Rift Albertine, République Démocratique du Congo.

INTRODUCTION

The Albertine Rift montane zone of Central Africa, extending from the Blue Mountains in the north (ca. 2°N, 30°30'E) to the southern end of Lake Tanganyika (ca. 9°S, 30°30'E), is recognized as one of Africa's biological hotspots due to high levels of species richness and endemism (Küper et al. 2004; Orme et al. 2005; Plumptre et al. 2007). Although numerous surveys have been conducted and published on the gorilla-inhabited Virunga-Bwindi heartland, many isolated areas, especially Congolese landscapes peripheral to this heartland, have never been properly surveyed. Here we describe two new species of the *Rhinolophus maclaudi* group of horseshoe bats. The group is readily diagnosed by their large ears and by the absence of a connecting process to the sella (Fahr et al. 2002). Specimens of a new species were first collected in hills overlooking Lake Tanganyika in the Misotschi-Kabogo highlands (5°–6°S). Subsequently, an independent team collected a second new species of this group in Kahuzi-Biega National Park, a World Heritage Site known for its eastern lowland gorilla population (*Gorilla beringei graueri* Matschie). These two new species bring the total number of species described within the *Rhinolophus maclaudi* group to six, four of them largely confined to montane habitats within the Albertine Rift.

MATERIALS AND METHODS

Bats, including three individuals representing a new species, were collected between 14 and 17 February 2007,

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Fig. 1. Above – View of Misotschi-Kabogo foothills from Lake Tanganyika. Note mature forest next to degraded patch near village. Below – Mosaic of forest and grassland as seen from summit of Misotschi-Kabogo escarpment (Photographs A. Plumptre).

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during the course of a preliminary small mammal survey in the Misotschi-Kabogo highlands overlooking the western shore of Lake Tanganyika, eastern Democratic Republic of Congo. A fourth individual was subsequently captured nearby, on the Kilicha River on 17 Feb 2007. All bat specimens were collected with mist nets, courtesy of the accompanying ornithologists. With a single exception, the new material discussed herein was collected during the course of the Misotschi-Kabogo expedition. The exception was a single horseshoe bat, also representing a new species, netted a few months later on the slopes of Mt Kahuzi during a survey of terrestrial small mammals and birds of Kahuzi-Biega National Park.

Data collected for all specimens included the macrohabitat, sex, and reproductive condition. The following standard external measurements were taken in the field: total length (Total), tail length (Tail), hind foot length (HF), ear length (Ear), forearm length (FA), and body mass (Mass). Head and body length (H&B) was determined by subtracting Tail from Total. All metrics are given in Tables 1 and 2. Voucher specimens were prepared as study skins and skeletons or were preserved in 10% formalin. For the latter group, skulls were later extracted at the Field Museum of Natural History (FMNH) in Chicago and transferred to 70% ethanol. The preservation of the specimen is recorded as ssk (skin, skull and skeleton), alc (alcoholic carcass), asr (alcoholic carcass with skull removed), or sko (skull and skeleton only).

External metrics of the bat specimens, excepting *Rhinolophus*, were taken by JCKP, using Mitutoyo CD-6"CSX calipers to the nearest .01 mm for craniodental variables and to the nearest 0.1 mm for external variables. JF took the measurements of the *Rhinolophus* as well as comparative museum specimens with Mahr 16 ES digital calipers and the same precisions. Definition of measurements (Table 1 & 2) is given in Fahr et al. (2002), with the following additional variables: HS-W: width of horseshoe; Trag: length of tragus; $CrnC_{alv}$: length of skull from posterior-most point to front of canine alveolus; $CbsC_{alv}$: length of skull from posterior-most point of condyles to front of canine alveolus; $C\text{-}C_{alv}$: width across alveoli of upper canines; $M^3\text{-}M^3{}_{alv}$: width across alveoli of posterior upper molars; $C\text{-}M^3{}_{alv}$: length of upper (maxillary) toothrow from front of canine to back of posterior molar at alveoli; M^1Br: breadth of first upper molar; $C\text{-}PM^2$: length from front of upper canine to back of posterior premolar; $PM^2\text{-}M^3$: length from front of posterior upper premolar to back of posterior molar; ManA: length of mandible from tip of angular process to anterior-most point, excluding incisors; $C\text{-}M/_{3alv}$: length of lower toothrow from front of canine to back of posterior molar at alveoli. Measurements are given in millimeters, body mass in grams.

Tissue samples were stored in the field in a saturated NaCl / EDTA buffer. Upon returning from fieldwork, tissues were stored in an ultracold freezer at -70°C. In the field, animals were handled in accordance with American Society of Mammalogists guidelines (Sikes et al. 2011).

Specimens were compared with material from the following institutions: American Museum of Natural History, New York (AMNH), Natural History Museum, London (BMNH), Institut royal des Sciences naturelles de Belgique, Bruxelles (IRSNB), Los Angeles County Museum of Natural History (LACM), Muséum d'Histoire naturelle Genève (MHNG), Musée Royal de l'Afrique Centrale, Tervuren (MRAC), Senckenberg Museum Frankfurt (SMF), and Zoologisches Museum of the University of Zürich (ZMUZ). The new collections are deposited at the Field Museum of Natural History, Chicago. D.C.M. refers to the field notes of David C. Moyer. Taxonomy follows Simmons (2005) unless stated otherwise.

STUDY AREAS

The Misotschi-Kabogo highlands of the eastern Democratic Republic of Congo run approximately 100 km along the escarpment above the western shore of Lake Tanganyika at an estimated width of 10–20 km. Topographically these highlands are separated from the Itombwe massif to the north by the Kilombwe valley, which is ca. 10 km wide at an altitude of 800–1100 m. The continuous forest cover of the Misotschi-Kabogo highlands on the one hand and the Itombwe forest on the other hand is separated by a stretch roughly 100 km wide. To the south, the Misotschi-Kabogo highlands are separated from the Marungu highlands, which lack noteworthy forest cover, by the Lukuga valley. With the exception of birds (Prigogine 1960), these highlands have been virtually unexplored by biologists. Prigogine (1955) described a new warbler (currently *Apalis porphyrolaema kaboboensis*) and collected a squirrel that was later described as a distinct subspecies (*Protoxerus stangeri kabobo* Verheyen, 1960). Prigogine also collected the type specimen of a distinct subspecies (Groves, 2005) of Angola colobus monkey, *Colobus angolensis prigoginei* (Verheyen 1959) from 'Mt Kabobo'. Plumptre et al. (2008) summarized preliminary results of a biodiversity survey of the Misotschi-Kabogo highlands and discussed the conservation significance of this region.

The escarpment is continuously forested from the lakeshore at 770 m up to the highest elevation at ca. 2700 m (Fig. 1 above). The main forest block is approximately 1,000 km^2 in size. On the western side, the highlands drop to a rather flat area at an altitude of ca. 1000 m, which is characterized by a heterogeneous mosaic of savannas and riverine forests of variable width (Fig. 1 below).

The camps within the Misotschi-Kabogo forest were accessed from two different fishing villages along the Lake Tanganyika shoreline. The camp where all but one of the bats were collected is located approximately 4 km south-

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west of the village of Talama, north of the town of Kalemie at 1950 m (4°59'29"S, 29°04'49"E). After exiting the forest and climbing a steep grassy ridge, the forest was again reached and the camp was set within a horseshoe bend of the Mukungu River. One specimen of the new *Rhinolophus* was collected at a separate locality referred to here as the Kilicha River locality at 1880 m (5°06'19"S, 29°03'56"E). Dominant tree species included *Syzygium guineense* (Willd.) DC., *Garcinia volkensii* Engl., and *Tabernaemontana johnstonii* (Stapf) Pichon. The climate of the two survey sites is characterized by a single wet season from October until April and a dry season from May until September, with an annual average precipitation of 1500–1550 mm, mean annual minimum temperature of 11.8°C, and mean annual maximum temperature of 21.5°C (Prigogine 1960, Hijmans et al. 2005).

The specimen from Kahuzi-Biega National Park was collected on the western slopes of Mt Kahuzi at an elevation of 2600 m (2°15'09"S, 28°40'9"E) in secondary forest with dominant tree species of *Nuxia floribunda* (Benth.), *Agauria salicifolia* (Hook.f. ex Oliv.), *Macaranga kilimandscharica* (Pax) and *Afrocarpus usambarensis* (Pilg.). The canopy was semi-closed at a height of 12 meters. The sub-canopy was semi-closed with dominant species of *Chassalia subochreata* (De Wild.) Robyns, *Polygala ruwenzoriensis* (Chodat), *Sericostachys scandens* (Gilg & Loper.), *Mimulopsis solmsii* Schweinf., *Mikania chevalieri* (C.D. Adams) W.C. Holmes & McDaniel, *Sinarundinaria alpina* (K. Schum.) *C.S. Chao & Renvoize* and *Tricalysia* sp. (A.Rich. ex DC). The climate is characterized by a single wet season from September until May and a dry season from June until August, with an annual average precipitation of 1850 mm, mean annual minimum temperature of 10.2°C, and mean annual maximum temperature of 18.6°C (Hijmans et al. 2005).

RESULTS

Myonycteris angolensis (Bocage) ssp.

FMNH 195081 (original number MHH 844), subadult female, collected on 16 February 2007 by B. D. Marks. Skin, skull and skeleton. Collected 4 km southwest of the village of Talama, N of Kalemie: 4°59'29"S, 29°04'49"E, 1950 m.

The single specimen slightly exceeds the dimensions of *Myonycteris angolensis ruwenzorii* (Eisentraut, 1965) and, despite being a subadult (basioccipital suture incompletely fused), falls within the size range of the largest subspecies, *M. a. goliath* (Bergmans, 1997). The latter author listed three females of *M. a goliath* from eastern Zimbabwe with FA 82.1, 83.8 and 89.6 (vs. FMNH 195081 with FA = 84.0) while Monadjem et al. (2010) gave a mean FA length of 83.9 ± 2.1 (range: 81.4–87.4) for six females from northern Mozambique. FA-ranges of 83 females of *M. a. ruwenzorii* are shorter with 72.8–83.0 (Bergmans 1997). Crn of FMNH 195081 is 43.85 and agrees with three females of *M. a. goliath* (45.8, ≥42.3, ≥42.2) while corresponding measurements of *M. a. ruwenzorii* range smaller (39.1–43.2, n=58; Bergmans 1997). In terms of distribution, the present specimen is located within the range of *M. a. ruwenzorii*, stretching from southern Sudan to southeastern D.R. Congo, while it is rather distant from the currently known distribution of *M. a. goliath* (E Zimbabwe & Mozambique). These data suggest that more material is needed to assess the taxonomic relationships of both taxa and their distributions; the elevation of *M. goliath* to species rank proposed by Cotterill (2001) seems premature. The transfer of *Lissonycteris angolensis* to genus *Myonycteris* follows Nesi et al. (2013).

Hipposideros* cf. *ruber (Noack)

FMNH 195085 (original number MHH 842), adult female, collected on 16 February 2007 by M. H. Huhndorf. Teats small (nulliparous). Skin, skull and skeleton. Collected 4 km southwest of the village of Talama, N of Kalemie: 4°59'29"S, 29°04'49"E, 1950 m.

The taxonomy of the *Hipposideros caffer/ruber* group is in flux due to pronounced cryptic diversity revealed by molecular genetics (Vallo et al. 2009). The latter study demonstrated that morphometrics previously used to distinguish species and subspecies show very limited match with molecular clades; hence we refrain from assigning the single specimen to any of the available names within this species complex. Our tentative identification as *H. ruber* follows the traditional concept, as the specimen is clearly larger than *H. caffer* (Sundevall); however, molecular data would be required for an unambiguous identification.

Hypsugo* cf. *eisentrauti (Hill)

FMNH 195086 (original number MHH 845), adult female, collected on 17 February 2007 by C. Kahindo. Teats small (nulliparous). Skin, skull and skeleton. Collected 4 km southwest of the village of Talama, N of Kalemie: 4°59'29"S, 29°04'49"E, 1950 m.

Our specimen is of large size (FA: 37.8), has a small upper premolar (PM^1) visible in lateral view, a broad and bicuspid inner upper incisor (I^1), a bicuspid outer incisor (I^2), and I^2 nearly reaches in height the lateral cusp of I^1. It is very similar in measurements to a specimen (SMF 79444) collected in the Nyungwe National Park, Rwanda, at 2500 m, referred to as *Hypsugo eisentrauti* by Volleth & Heller (1994), Heller et al. (1995), and Volleth et al. (2001). Although both of these specimens have similar external measurements compared to type specimens of *Hypsugo eisentrauti* from Cameroon, they are distinctly

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Table 1. External and craniodental measurements of Chiroptera other than *Rhinolophus*.

	Myonycteris angolensis	*Hipposideros* cf. *ruber*	*Hypsugo* aff. *eisentrauti*		*Hypsugo eisentrauti*			
Museum	FMNH 195081	FMNH 195085	FMNH 195086	SMF 79444	ZFMK 68.5	ZFMK 68.6	BMNH 67.2129 #	BMNH 84.1684 §
Country	DR Congo	DR Congo	DR Congo	Rwanda	Cameroon			
Sex	♀	♀	♀	♂	♂	♀	♀	♂
Mass	82	10	9.8	12*(full)	7.0	8.3		
Total	136	93	93		84	88		
H&B	126	59	58		48	48		
Tail	10	34	35	36	40			
Ear	25	16	12	12.2	11	13		
Tragus			4.0	4.7	5.1	4.6		
FA	84.0	52.3	37.8	35.8	33.9	36.3	34.2	35.5
3Meta	57.7	38.7	34.6	34.3	30.9	33.2		31.2
3Pha1	41.7	16.4	12.5	13.2	10.7	12.5		
3Pha2	51.3	17.2	11.2	10.1	10.8	10.3		
3Pha3			5.9	6.2	5.1	5.6		
4Meta	54.9	36.3	33.2	33.4	30.1	32.8		
4Pha1	31.7	11.9	11.1	12.1	9.9	11.0		
4Pha2	33.1	9.0	9.6	9.2	9.2	9.0		
5Meta	54.4	31.8	32.6	33.0	28.9	31.7		
5Pha1	27.0	14.5	8.0	9.1	7.3	7.8		
5Pha2	31.2	10.4	5.5	5.0	5.0	5.0		
Tibia			13.8	14.2	12.1	13.4		
HF_{su}	17.8	7.9	7.1	6.9	7.0	6.8		
HF_{cu}	21.6*	9.9*	8.6	7.3		8.1		
Crn	43.85	18.63	14.76	14.88	13.68	14.16	14.0	14.0
CrnC	42.72	18.35	14.59					
Cbs	41.86	16.42	14.10	14.39	13.16	13.63	13.3	13.7
CbsC	40.52	16.03	13.76					
Mast	16.47	9.93	8.60	8.45	7.77		7.9	8.1
Zyg	24.32	9.53	10.74	10.65	9.61	[9.54]		
BcB	17.04	8.44	7.83	7.50	7.36	7.46	7.2	7.0
BcH	12.07	6.79	5.83	5.70	5.54	5.38		
C-C	8.01	4.15	4.95	5.20	4.60	4.23	4.5	5.0
M^3-M^3	12.31	6.37	6.73	6.75	6.06	6.3 #	6.3	6.3
C-M^3	16.8	6.34	5.34	5.59	5.22	5.1 #	5.0	5.3
PoC	8.77	3.11	4.48	4.10	4.27	4.25	4.2	3.9
ManC	32.7	11.32	10.87	11.10	10.33	10.73	9.9	10.9
C-M_3	18.44	6.68	5.72	5.98	5.51	5.67	5.5	5.8

Hill 1968, De Vree, 1972; § measurements courtesy of Dieter Kock. SMF 79444: Rwanda, near Cyangugu, Nyungwe NP, 2500 m, leg. K.-G. Heller & M. Volleth, F-N° 339, 28 Mar 1990, skin & skull; ZFMK 68.5 (holotype *eisentrauti*): Cameroon, Rumpi Hills, Dikume-Balue, camp V, leg. M. Eisentraut, F-N° 498, 18 Feb 1967, skin & skull; ZFMK 68.6 (paratype *eisentrauti*): Cameroon, Mt Kupe, camp II, ca. 1100 m, leg. M. Eisentraut, F-N° 198, 30 Nov 1966, skin & skull; BMNH 67.2129 (paratype *eisentrauti*): Cameroon, Mt Cameroon, Buea, leg. M. Eisentraut, F-N° 643, 15 Mar 1967, skin & skull; BMNH 84.1684: Cameroon, Mt Cameroon, 750 m; leg. M. O. Fedden & H. L. Macleod, F-N° 61, 2 Jan 1984, alc. & skull.

larger in several craniodental measurements (e.g. Crn, Cbs, Mast, Zyg, M^3-M^3; Table 1). Similar to true *Hypsugo eisentrauti*, the pelage of our specimen is unicolored dark brown above and slightly bicolored below. However, our specimen is much paler ventrally with brown roots tipped with pale brown. Based on available data, specimens FMNH 195086 and SMF 79444 appear to represent an undescribed species (see also Van Cakenberghe & Happold 2013).

***Rhinolophus willardi* sp. nov.** Kerbis Peterhans & Fahr Willard's Horseshoe Bat

Holotype. FMNH 195182 (original number D.C.M. 1680). Adult male, all teeth in wear. Collected on 17 February 2007 by A. J. Plumptre & E. A. Mulungu. Specimen preserved in alcohol with skull removed.

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Fig. 2. Left – Type locality of *Rhinolophus willardi*. Note large amount of epiphytes on trees near Kilicha River. Right – Aerial view of artisanal mining site within forest of Misotschi-Kabogo highlands (Photographs A. Plumptre).

Type locality. Misotschi-Kabogo highlands, north of Kalemie, Kilicha River, above the western shore of Lake Tanganyika, South Kivu Province, eastern Democratic Republic of Congo, 5°06'19"S, 29°03'56"E, 1880 m. The holotype was captured in a clearing near a stream in a deep valley (Fig. 2, left). The forest covering the surrounding slopes was dense with tall trees (40–50 m) covering the surrounding slopes and had a fairly open understorey. The clearing was formed in an area where the stream had deposited gravel in the wet season but was at a much lower level at the time of capture (dry season).

Paratypes. All from 4 km SW of the village Talama, 'Camp 2', 4°59'29"S, 29°04'49"E, 1950 m, and all preserved as skin, skull and post-cranial skeletons. FMNH 195082, adult male, original number MHH 837, collected by B. D. Marks on 14 Feb 2007, with convoluted epididymes and abdominal testes (3x2 mm). FMNH 195083, adult female, original number MHH 838, collected by B. D. M. on 14 Feb 2007, with enlarged nipples but nulliparous. FMNH 195084, adult female, original number PK 754, collected by B. D. M. on 16 Feb 2007 without embryos.

Etymology. The specific epithet honors Dr. David Willard (Collection Manager, Division of Birds, FMNH) in recognition of his unparalleled 35+ years of service to the Field Museum of Natural History. While devoting 80+ hours a week to the job and generously sharing his time and expertise as an ornithologist and educator, Dave also brings an unmatched ethical standard. Although he did not collect these particular bats, Dave has contributed to the documentation of Chiropteran diversity throughout his career and, as a consequence, has documented the distribution of more mammal species in the Neotropics, Asia and Africa than the vast majority of field mammalogists.

Diagnosis. Immediately recognized as a part of the *Rhinolophus maclaudi* species group (Fahr et al. 2002) due to the large ears and the poorly developed connecting process behind the sella (Fig. 3). Within this group it is the smallest in most metrical dimensions, particularly FA, cranium, and palatal length. Twelve internal ear folds.

Description. Secondary horseshoe leaflet present and trilobate, connecting process and anterior face of sella clad with long hairs, horseshoe densely clad with short hairs (Fig. 4); dorsal pelage somewhat wooly (length of hairs ca. 11.9 mm), hairs unicolored, smoky-brown; ventral pelage more grayish with a slight sheen (length of hairs ca. 9.4 mm); membranes dark smoky-brown; skin of noseleaf dark grey. Connecting process of sella shoulder-like in lateral view where meeting sella from behind (point of insertion of shoulder to tip of sella: 1.45 mm). Ears relatively short (49–56% of FA-length), twelve internal folds. Bulla length: 4.1–5.0, bulla width: 2.05–2.06. Skull axis in lateral view more or less straight (as opposed to *R. maclaudi*). Profile of parietal, in lateral view, is variable (Fahr et al. 2002, Fig. 3), with both concave (as *R. ruwenzorii*) and more straight outlines (as *R. hilli*). Position of anterior margin of rostral swelling, in lateral view, ranges between the front and the center of upper M^1. Saddle between inflation and frontal pronounced, posterior slope of inflation both illustrating steep (more similar to *R. ruwenzorii*) and moderately steep profiles (more similar to *R. hilli*) in lateral view (ibid). Squamosal root of zygoma at

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Table 2. External and craniodental measurements of *Rhinolophus willardi* sp. nov., *R. kahuzi* sp. nov., *R. hilli*, and *R. ruwenzorii*.

	Rhinolophus willardi sp. nov.				*R. kahuzi* sp. nov.	*R. hilli*		*R. ruwenzorii* #	
	FMNH 195182	FMNH 195082	FMNH 195083	FMNH 195084	FMNH 219793	ZMUZ 126639	MRAC 82006M1	Mean±*SD*	Range, sample size
Sex	♂	♂	♀	♀	♂	♀	♀	19 ♂♂, 9 ♀♀	
Mass		14	15	16	13		16.5	17.6±1.5	16.0–19.5, n=7
Total		87	92	95	81	92.0		93.7±5.3	83.0–104.0, n=24
H&B		61	66	73	57	62.7		63.3±5.1	52.0–72.0, n=27
Tail	23.4	26.0	26	22	24.1	29.3		29.5±2.5	25.0–35.0, n=25
Ear	24.2	29	28	29	34.5	28.5		35.6±2.1	32.0–40.0, n=27
HS-W	12.1	10.9*	10.7*	10.3*	11.7			11.8±0.8	10.3–13.0, n=20
FA	49.7	51.5	50.8	51.4	54.5	54.3	54.2	57.6±1.9	55.0–61.7, n=28
3Meta	33.2	35.0	35.3	36.8	38.9	37.1		39.8±1.7	37.4–43.6, n=26
3Pha1	16.0	16.6	15.7	16.8	17.1	17.2		18.3±1.2	15.9–21.1, n=26
3Pha2	25.7	28.0	28.4	27.2	29.5	29.3		30.6±1.4	27.8–32.8, n=26
4Meta	36.7	38.2	37.8	38.8	41.0	40.9		42.6±2.0	39.2–46.9, n=26
4Pha1	10.2	9.8	9.5	10.2	11.3	10.9		11.4±0.8	9.5–12.8, n=26
4Pha2	15.9	16.5	16.3	16.7	18.5	19.1		19.3±0.8	17.7–20.9, n=26
5Meta	36.3	37.9	38.7	39.3	43.3	41.0		43.4±2.0	39.6–46.8, n=26
5Pha1	11.4	12.0	12.9	12.7	11.7	12.7		13.0±0.7	11.3–14.1, n=25
5Pha2	15.2	15.7	15.3	15.2	16.0	18.5		17.4±0.8	15.7–18.9, n=24
Tibia	20.7	20.0		20.7	21.9	23.8		23.5±1.1	21.7–26.0, n=26
HF_{su}	10.7	11.0	11.6	10.7	11.1	11.1		11.6±0.8	10.0–13.0, n=26
HF_{cu}	12.0	12.5	12.5	12.1	12.3	12.2		13.2±0.8	11.7–14.5, n=12
Crn		22.60			24.20	23.89	23.3	25.41±0.73	24.20–26.37, n=9
CrnC	21.74	22.38	22.07	22.25	23.43	23.02		24.48±0.68	23.65–25.55, n=13
$CrnC_{alv}$	21.45	21.96	21.62	21.88	23.19	22.79		24.62±0.48	24.16–25.19, n=4
Cbs		19.96			21.24	21.22	20.7	22.90±0.50	22.00–23.62, n=9
CbsC	19.28	19.72	19.39	19.76	20.47	20.19		21.64±0.66	20.70–22.70, n=13
$CbsC_{alv}$	18.85	19.36	18.93	19.36	20.30	19.97		21.88±0.77	21.10–22.82, n=4
Mast	10.37	10.67	10.64	10.69	11.58	10.90	11.2	11.97±0.26	11.20–12.30, n=18
Zyg	10.30	10.35	10.85	10.57	10.61	10.60	10.9	11.07±0.23	10.50–11.40, n=18
BcB	9.00	9.32	9.45	9.36	9.97	9.96	10.1	10.06±0.26	9.85–10.81, n=12
BcH	6.87	6.93	7.23	7.14	7.07	6.92		7.28±0.27	6.85–7.67, n=12
C-C	5.58	5.66	5.71	5.65	5.04	5.67	5.6	5.61±0.15	5.30–5.90, n=19
$C\text{-}C_{alv}$	5.41	5.44	5.58	5.55	4.96	5.64		5.58±0.10	5.46–5.65, n=3
$M^3\text{-}M^3$	7.72	7.74	8.07	7.84	7.44	7.81	8.0	7.72±0.23	7.30–8.20, n=20
$M^3\text{-}M^3{}_{alv}$	7.44	7.48	7.75	7.63	7.28	7.91		7.44±0.18	7.05–7.75, n=13
$C\text{-}M^3$	7.73	7.99	7.97	7.99	8.04	8.08	7.9	8.44±0.23	8.15–8.90, n=14
$C\text{-}M^3{}_{alv}$	7.51	7.66	7.55	7.56	7.88	7.78		8.29±0.28	7.90–8.70, n=6
M^1Br	2.16	2.03	2.24	2.17	1.78	2.12		1.98±0.10	1.88–2.12, n=4
$C\text{-}PM^2$	3.21	3.38	3.30	3.41	3.33	3.55		3.67±0.08	3.59–3.74, n=3
$PM^2\text{-}M^3$	5.95	6.19	6.22	6.13	6.07	6.57		6.46±0.21	6.15–6.80, n=9
InflB	4.16	4.25	4.16	4.30	—	4.55		4.56±0.29	4.40–4.99, n=4
$RostrB_{infl}$	6.06	6.34	6.20	6.43	6.88	6.41		6.74±0.11	6.60–6.97, n=14
PalateL	3.04	3.15	3.12	3.09	3.40	3.58		3.65±0.21	3.25–4.20, n=19
PalateB	3.37	3.43	3.22	3.38	3.20	3.90		3.67±0.17	3.53–3.86, n=3
PoC	3.00	3.06	2.97	2.83	3.21	2.82	2.5	2.83±0.21	2.50–3.30, n=19
ManC	14.37	14.53	14.84	14.49	14.78	14.96	15.4	15.83±0.45	15.10–16.45, n=13
ManA	14.19	14.52	14.64	14.44	14.35	14.86		15.48±0.43	15.00–15.82, n=3
C-M/3	8.16	8.40	8.59	8.42	8.29	8.50	8.5	8.79±0.18	8.45–9.10, n=15
$C\text{-}M/3_{alv}$	7.93	8.21	8.32	8.22	7.95			8.73±0.20	8.54–8.93, n=3

AMNH 82394 (holotype), BMNH 55.1187, 60.99 – 60.101, FMNH 144309 – 144312, 160357, IRSNB 7047, LACM 51751, 57774, 57776, MHNG 1873.10 – 1873.14, MRAC 85006M447, 85006M448, 35170, 35173, 35206, 35208, 35211, 35217, 35218. For further details, see Appendix 2.

* Horseshoe width measured from dried skin, hence shrunk and originally probably larger.

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Fig. 3. Photographs (A. Plumptre) of the holotype (FMNH 195182) of *Rhinolophus willardi* sp. nov.

glenoid in ventral view broad and strut-like for a length of 1.2 mm before it steps down anteriorly. Canine and second upper premolar almost in contact, anterior upper premolar extruded from the tooth row. Mast nearly equal to Zyg (ratio: 0.97–1.02).

Comparisons. The following features are shared with all members of the *Rhinolophus maclaudi* group from the Albertine Rift: *R. ruwenzorii* (SW Uganda, eastern DR Congo and NW Rwanda), *R. hilli* (SW Rwanda), and *R. willardi* sp. nov. (western slopes of Lake Tanganyika) and distinguish them from the two West African taxa (*R. ziama* and *R. maclaudi*). Secondary leaflets present beneath the horseshoe. The anterior margin of the horseshoe has a median emargination half the height of the horseshoe rim. The highest point of braincase is at the height of the glenoid process. The chambers of rostral swellings in dorsal view are subcircular with slight but well-defined postero-me-

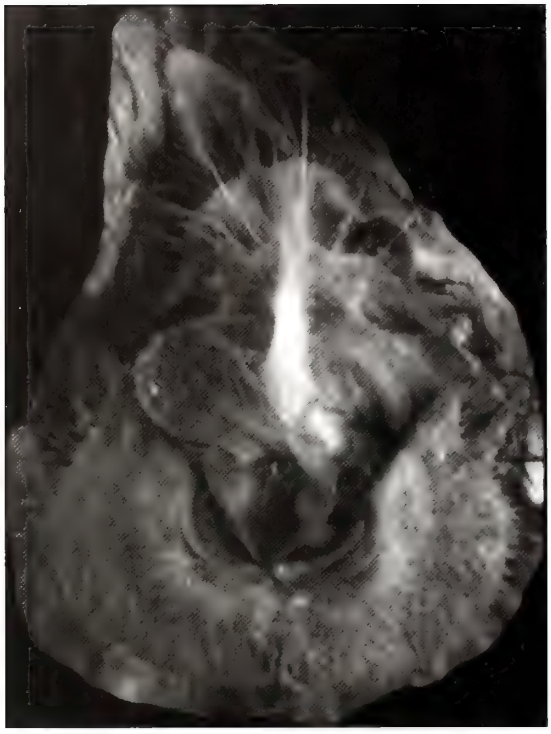

Fig. 4. Noseleaf of the holotype (FMNH 195182) of *Rhinolophus willardi* sp. nov. (Photograph J. Weinstein).

dian angulation. The infraorbital bridge is short and stout. All of the eastern taxa are smaller in size. These shared similarities suggest that the eastern and western taxa represent two distinct clades within the *R. maclaudi* group.

Rhinolophus willardi sp. nov. averages smaller than *R. ruwenzorii* in most measurements, with no overlap in Ear, FA, 3Meta, 4Meta, 4Pha2, 5Meta, Tib, CrnC, CbsC, Mast, BcB, C-M^3, C-PM^2, InflB, $RostrB_{infl}$, PalatL, PalatB, and ManC. Its body mass is also lower. However, the anterior upper molar (M^1) of *R. willardi* sp. nov. appears broader than in *R. ruwenzorii* while it averages similar to *R. ruwenzorii* in a few craniodental measurements (C-C, M^3-M^3, PoC). Compared to *R. hilli*, the smallest currently recognized member of the group, *R. willardi* sp. nov. is smaller in most measurements, with no overlap in FA, 3Meta, 3Pha1, 3Pha2, 4Meta, 4Pha1, 4Pha2, 5Meta, 5Pha2, Tib, CrnC, CbsC, Mast, BcB, InflB, and PalatL. However, it is similar or slightly larger than *R. hilli* in some craniodental measurements (Zyg, C-C, M^3-M^3, PoC, M1Br) with tooth rows that are proportionately long (C-M_3, C-M^3) and a proportionately higher braincase (BcH).

Rhinolophus willardi has twelve internal ear folds compared with 8–9 in *R. ruwenzorii* / *hilli*. The shape of sella, in frontal view, is constricted at the base and rounded terminally. Maxillary bone in dorsal view visible along the entire length, whereas in *R. hilli* and *R. ruwenzorii* it is concealed by the rostral inflations. Anterior portion of rostral sinus in lateral view steeply rising, inflation almost completely included in rostral sinus (more similar to *R. hilli*). The new species differs from *R. hilli* with a braincase that, in dorsal view, is constricted behind the mastoid process. Posterior slope of braincase in lateral view more horizontal than the sharply dropping slope of *R. hilli*. Relative size of lower molars very large (even slightly larger than in *hilli*). Zygomatic breadth is more or less equal to the mastoid width as opposed to *R. hilli/ruwenzorii* where the zygomatic breadth is narrower.

***Rhinolophus kahuzi* sp. nov.** Fahr & Kerbis Peterhans Kahuzi Horseshoe Bat

Holotype. FMNH 219793 (original number JCK 5406). Subadult male. Collected on 28 July 2007 by R. Kizungu. Specimen preserved in alcohol with skull removed.

Type locality. Western slope of Mt Kahuzi, Kahuzi-Biega National Park, South Kivu Province, eastern Democratic Republic of the Congo, 2°15'09"S, 28°40'09"E, 2600 m. Found within mixed *Afrocarpus* and *Nuxia* forest on the slope of Mt Kahuzi.

Etymology. The specific epithet refers to the type locality, and is used as a noun in apposition.

Diagnosis. Immediately recognized as a part of the *Rhinolophus maclaudi* species group (Fahr et al. 2002) due

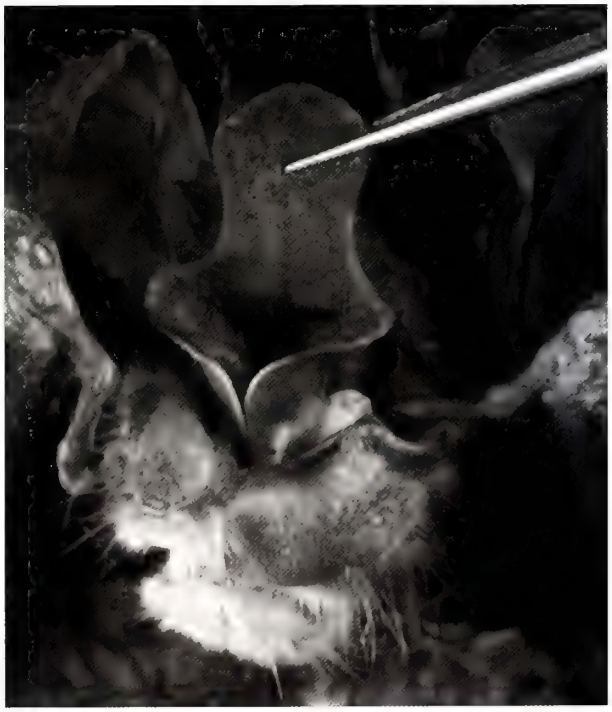

Fig. 5. Partial noseleaf and sella of the holotype (FMNH 219793) of *Rhinolophus kahuzi* sp. nov. (Photograph J. Weinstein).

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Fig. 6. Skulls in dorsal, ventral, and lateral views. From upper left, clockwise: *Rhinolophus ruwenzorii*, holotype, AMNH 82394; *R. hilli*, holotype, ZMUZ 126639; *R. kahuzi* sp. nov., holotype, FMNH 219793; *R. willardi* sp. nov., holotype, FMNH 195182.

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to the large ears and the poorly developed connecting process behind the sella. Within this group, it is recognized by its large ears with 11 internal ear folds.

Description. Body – Moderately large rhinolophid (FA: 54.5 mm, Mass: 13 g). Pelage somewhat wooly with unicolored hairs, dorsally dark smoky-brown (length of hairs ca. 11 mm), ventrally barely paler and slightly more grayish (length of hairs ca. 9 mm). Membranes dark smoky-brown; noseleaf dark gray.

Noseleaf & ears – Horseshoe with deep median emargination, margin slightly "wavy" on the left side, ragged (coarsely serrated) on the right side (probably injured). One distinct triangular flap at the posterior point before the horseshoe meets the noseleaf, with a rim leading from cup of nostril backwards to base of triangular flap. Tip of sella broad and rounded with its greatest width at 4.9 mm and with a mid-length constriction of 3.8 mm (Fig. 5). Anterior face of sella and horseshoe densely clad with very short hairs. Weakly developed secondary leaflets with ragged edge, completely concealed by horseshoe. Lancet triangular with narrow tip; connecting process low. Ears relatively very long (63 % of FA-length), conch with 11 internal folds.

Skull & dentition – Upper incisors bilobed. Anterior upper premolar (PM^1) present on both sides and small, only slightly extruded from tooth row, canine and anterior upper premolar (PM^2) not in contact; PM^2 clearly not as broad as first upper molar (M^1). In lateral view (Fig. 6), upper edge of zygomatic arch without notch. Anterior slope of rostral sinus very angular below inflations (cf. fig. 6 in Fahr et al. 2002). Moderately developed sagittal crest along the anterior half of the braincase. Infraorbital bridge short and very stout. In dorsal view (Fig. 6), braincase constricted behind mastoid process. Premaxillae moderately broad; molars completely concealed by rostrum. Lower incisors trilobed, slightly imbricated. Middle lower premolar (PM_2) present on both sides and small, completely extruded from tooth row. Mastoid width broader than zygomatic width (ratio: 0.92), width across canines (C-C) small, and anterior upper molar (M^1) narrow.

Comparisons. Due to its small size (FA<55) and the presence of a secondary leaflet beneath its horseshoe, *R. kahuzi* sp. nov. needs comparison only with those species of the *R. maclaudi* group inhabiting the Albertine Rift: *R. willardi* sp. nov. (described above from the Misotschi-Kabogo highlands), *R. hilli* (from SW Rwanda) and *R. ruwenzorii* (SW Uganda, eastern DR Congo and NW Rwanda). *Rhinolophus kahuzi* sp. nov. is larger than *R. willardi* sp. nov. in most external (e.g. Ear, FA, 3Meta, 3Pha1, 3Pha2, 4Meta, 4Pha1, 4Pha2, 5Meta, 5Pha2, Tib) and several craniodental measurements (CrnC, CbsC, Mast, BcB, RostrB_{infl}, PalatL, PoC) while smaller in a few dental measurements (C-C, M^3-M^3, M^1Br).

In most dimensions, the new taxon is similar to *R. hilli*, another small member of the group (Table 2). *Rhinolophus kahuzi* boasts 11 internal ear folds compared with 12 in *R. willardi* sp. nov. and 8–9 in *R. ruwenzorii* / *hilli*, and has very large ears (34.5 vs. 24.2–29 in *R. willardi* sp. nov., and 28.5 in *R. hilli*. Compared to *hilli*, *R. kahuzi* sp. nov. has very similar external measurements, but with much smaller width across upper canines (C-C) and molars (M^3-M^3), shorter PM^2-M^3, shorter palatal breadth, but broader rostrum at height of inflations. The shape of the sella, in frontal view, is constricted at the base and rounded terminally. Maxillary bone, in dorsal view, visible along entire length (as in *R. willardi*) whereas in *R. hilli* and *R. ruwenzorii*, it is obscured by the rostral inflations. As does *R. willardi*, the new species differs from *R. hilli* with a braincase that, in dorsal view, is constricted behind the mastoid process. Posterior slope of braincase in lateral view drops sharply at 45° degree angle unlike the more horizontal plane of *R. willardi*.

Conservation status. *R. ruwenzorii* – VU B1ab(ii,iii,iv,v) (six out of 15 localities in protected areas), *R. hilli* – CR B1ab(iii,v)+2ab(iii,v) (both localities in one protected area), *R. kahuzi* (single locality in protected area) & *R. willardi* (both localities in unprotected areas): DD?

DISCUSSION

The *Rhinolophus maclaudi* complex now boasts six species, three having been described in the past decade. Shared characters unite the western and eastern branches of the complex into sister clades, but these relationships have not been confirmed with molecular data. There appears to be a cline of decreasing size as one moves from west to east and then, in the east, from north to south.

Our survey essentially presents the first bat records for the Misotschi-Kabogo highlands. Since these records were collected by the ornithological team, the documented richness of four bat species is certainly only a glimpse of the total bat diversity. In addition to our records, there is a single specimen of *Eidolon helvum* (MRAC 27113, leg. A. Prigogine, 18 Feb 1957) from Mt Kabobo. Given that these few records included a new horseshoe bat (*Rhinolophus willardi* sp. nov.), as well as a potentially undescribed pipistrelle bat, *Hypsugo* cf. *eisentrauti*, additional discoveries are highly likely. Furthermore, the elevational gradient with continuous forest cover across the eastern slope of the Misotschi-Kabogo highlands would provide untapped opportunities to study bat diversity in relation to altitude in this outstanding biogeographic hotspot (see Curran et al. 2012).

These discoveries, over the course of only a few nights in collecting effort, highlight the importance of surveying remote, undocumented African habitats and further in-

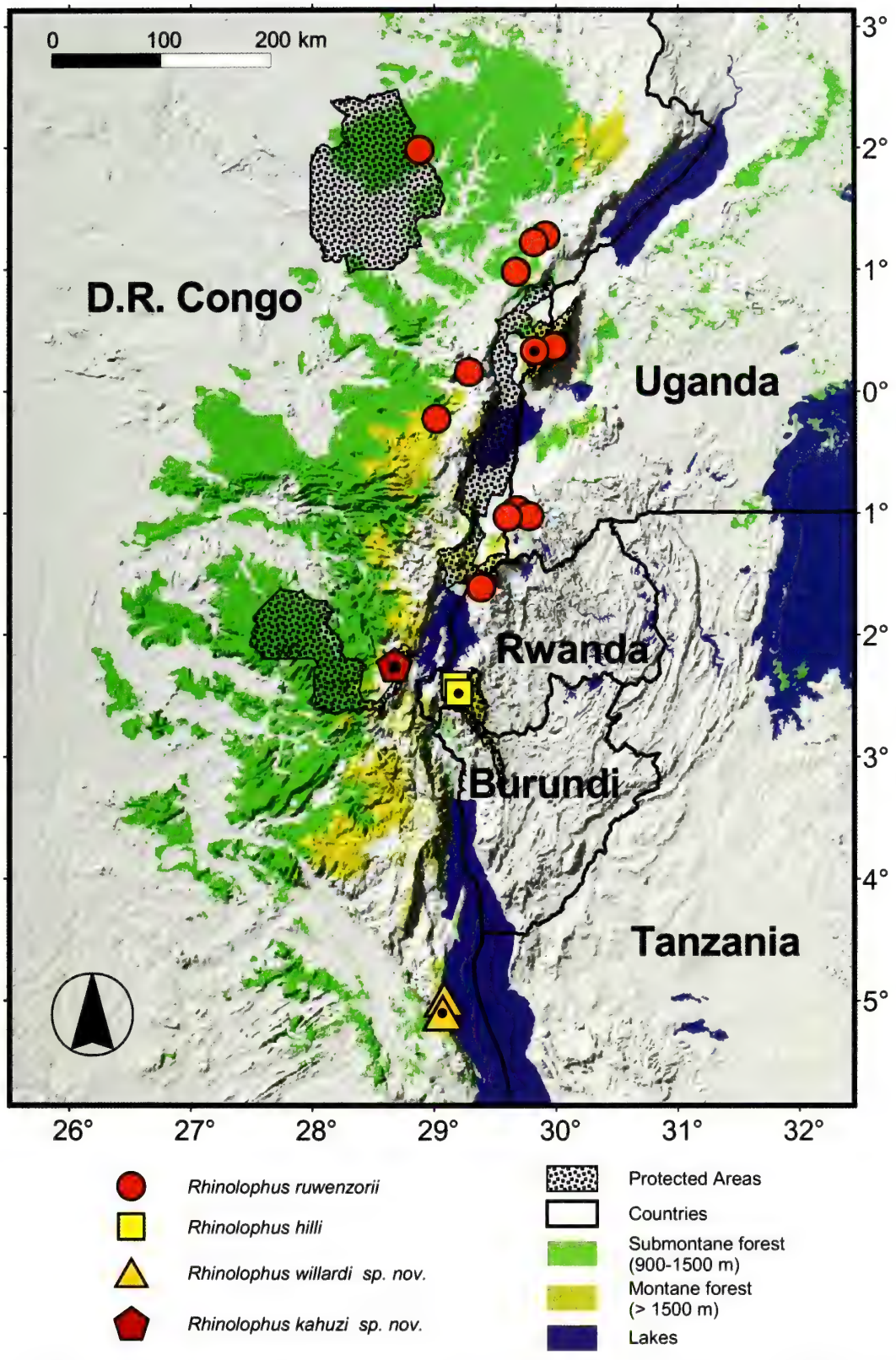

Fig. 7. Distribution of species of the *Rhinolophus maclaudi*-group in the Albertine Rift. Type localities indicated with a black central dot. Extent of montane and submontane forest from GLC 2000 (Mayaux et al. 2004), protected areas (IUCN categories II & IV, World Heritage Sites) from WDPA (IUCN & UNEP 2010). For data on localities, see Appendix 2.

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Table 3. List of mammal species currently recognized as endemic to the Albertine Rift.

Taxon (number of endemics, 43–49)	(Author) Reference
Primates (1)	
Gorilla beringei	(Matschie, 1903) Groves 2005
Eulipotyphla (16–19)	
Crocidura kivuana	(Heim de Balsac, 1968) Hutterer 2005
Crocidura lanosa	(Heim de Balsac, 1968) Hutterer 2005
Crocidura maurisca[2]	(Thomas, 1904) Hutterer 2005
Crocidura niobe	(Thomas, 1906) Hutterer 2005
Crocidura stenocephala	(Heim de Balsac, 1979) Hutterer 2005
Crocidura lwiroensis (sp. nov.)	(Kerbis Peterhans & Hutterer, 2013)
Myosorex bururiensis	(Kerbis Peterhans et al., 2010)
Myosorex jejei	(Kerbis Peterhans et al., 2010)
Myosorex kabogoensis (sp. nov.)	(Kerbis Peterhans & Hutterer, 2013)
Myosorex babaulti	(Heim de Balsac & Lamotte, 1956) Hutterer 2005
Myosorex blarina	(Thomas, 1906) Hutterer 2005
Myosorex schalleri	(Heim de Balsac, 1966) Hutterer 2005
Paracrocidura graueri	(Hutterer, 1986) Hutterer 2005
Paracrocidura maxima	(Heim de Balsac, 1959) Hutterer 2005
Ruwenzorisorex suncoides	(Osgood, 1936) Hutterer 2005
Scutisorex somereni [1,2]	(Thomas, 1910) Hutterer 2005
Suncus hututsi[2]	(Kerbis Peterhans & Hutterer, 2009)
Sylvisorex lunaris	(Thomas, 1906) Hutterer 2005
Sylvisorex vulcanorum	(Hutterer & Verheyen 1985) Hutterer 2005
Afrosoricida (1)	
Micropotamogale ruwenzorii	(de Witte & Frechkop, 1955) Bronner & Jenkins 2005
Chiroptera (4)	
Rhinolophus hilli	(Aellen, 1973) Fahr et al. 2002
Rhinolophus kahuzi (sp. nov.)	(Fahr & Kerbis Peterhans, this volume)
Rhinolophus ruwenzorii	(Hill, 1942) Fahr et al. 2002
Rhinolophus willardi (sp. nov.)	(Kerbis Peterhans & Fahr, this volume)
Rodentia (21)	
Funisciurus carruthersi	(Thomas, 1906) Thorington & Hoffman 2005
Heliosciurus ruwenzorii	(Schwann, 1904) Thorington & Hoffman 2005
Tachyoryctes ruandae	(Lönnberg & Gyldenstolpe, 1925) Musser & Carleton 2005
Delanymys brooksi	(Hayman, 1962) Musser & Carleton 2005
Dendromus kahuziensis	(Dieterlen, 1969) Musser & Carleton 2005
Lophuromys medicaudatus	(Dieterlen, 1975) Musser & Carleton 2005
Lophuromys rahmi	(Verheyen, 1964) Musser & Carleton 2005
Lophuromys stanleyi	(Verheyen et al., 2009)
Lophuromys woosnami	(Thomas, 1906) Musser & Carleton 2005
Dasymys montanus	(Thomas,1906) Musser & Carleton 2005
Dasymys rwandae	(Verheyen et al., 2003) Musser & Carleton, 2005
Grammomys dryas	(Thomas, 1907) Musser & Carleton 2005
Hybomys lunaris	(Thomas, 1906) Musser & Carleton 2005
Hylomyscus denniae	(Thomas, 1906) Musser & Carleton 2005
Hylomyscus vulcanorum	(Lonnberg & Gyldenstolpe, 1925) Musser & Carleton 2005
Mus bufo	(Thomas, 1906) Musser & Carleton 2005
Praomys degraaffi	(van der Straeten & Kerbis Peterhans, 1999) Musser & Carleton 2005
Thamnomys kempi	(Dollman, 1911) Musser & Carleton 2005
Thamnomys venustus	(Thomas, 1907) Musser & Carleton 2005
Otomys denti	(Thomas, 1906) Musser & Carleton 2005
Otomys dartmouthi	(Thomas, 1906) Musser & Carleton 2005
Carnivora (0–1)	
Genetta victoriae[1]	(Thomas, 1901) Wozencraft 2005
Artiodactyla (0–2)	
Syncerus matthewsi[?]	(Lydekker, 1904) Groves & Grubb 2011
Cephalophus rubidus[?]	(Thomas, 1901) Jansen van Vuuren & Robinson 2001

[?] taxonomic status in question
[1] species extends westward into Congo Basin but distribution centered on Albertine Rift
[2] montane status unclear

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dicate how much there is yet to learn of African biodiversity. Montane communities contain reservoirs of biodiversity that are inherently isolated. Their exploration must be placed at the forefront of survey and conservation efforts, especially in this era of dramatic climatic change. It had been previously claimed that the Albertine Rift did not warrant recognition as a biodiversity hotspot due to inadequate knowledge (Myers et al. 2000). Continued surveys, such as the ones reported on here, are rapidly dispelling this notion. Since 1999 our teams have described eight small mammal species new to science from the Albertine Rift region (Van der Straeten & Kerbis Peterhans 1999; Kerbis Peterhans & Hutterer 2009; Kerbis Peterhans et al. 2010; Kerbis Peterhans et al. 2013; this paper). The four new species from the Misotschi-Kabogo Highlands and Kahuzi-Biega National Park described in this volume bring the total of Albertine Rift montane endemics to a minimum of 43–49 species, by far the largest endemic montane fauna in Africa (Table 3, see also Kerbis Peterhans et al. 1998; Kaleme et al. 2007; Carleton et al. 2006). Clearly it is time to prioritize the status of this exceptional reservoir of biodiversity as it also houses the richest endemic montane faunas of birds (Strattersfield et al. 1998; Voelker et al. 2010), butterflies (Carcasson 1964) and perhaps reptiles and amphibian (i.e. Greenbaum & Kusamba 2012 for a recent review) on the continent.

All of the newly described forms have been uncovered through traditional field surveys to remote areas followed up by morphological diagnoses and comparisons with representatives from adjacent montane blocks. Such efforts are not possible without the use of museum collections and their associated reference materials. None of these forms was resurrected from synonymy nor first diagnosed through molecular techniques. Our methods are available to all parties, especially to those custodians in tropical regions and not just those with access to modern laboratories and facilities.

We are pleased to recognize interest and support from non-governmental organizations (NGOs), who have provided various groups with the resources to begin surveys of the unexplored pockets within the ecoregion (see Acknowledgements). Discoveries of rare species or species new to science have the potential to serve as flagship species for areas that lack formal protection. Finally, the timely turnover from field survey to academic manuscript (as exemplified by this journal) further illustrates that the oft-ignored small mammal community should be fundamental in biodiversity surveys.

Acknowledgements. The expedition to the Misotschi-Kabogo highlands was initiated by the Wildlife Conservation Society (WCS). Field work was spearheaded by A. J. Plumptre and D. Kujirakwinja in conjunction with the Research Staff at Lwiro (CRSN, Democratic Republic of Congo), the Field Museum of Natural History (Chicago) and the World Wide Fund for Nature (WWF). Additional funding came from the Daniel K. Thorne Foundation, the John D. and Catherine T. MacArthur Foundation, and the US Fish and Wildlife Service. In the Kabogo highlands, we acknowledge J. Badesire for logistical support, E. A. Mulungu provided critical field support, and G. Lukole and G. M. Mwankasala provided security and field logistics and local introductions. D. Pazo (CRSN, Lwiro) provided details on the botanical communities of Mt. Kahuzi. We thank J. Mwanga (Head, Biology) and B. Bajope (Director) of the Centre de Recherche en Sciences Naturelles at Lwiro for continuous assistance in collecting and with export permits. ECHO provided air transport. We recognize FMNH staff for their assistance: M. Schulenberg, J. Phelps, and W. T. Stanley. The senior author acknowledges the Barbara Brown Fund and the African Council of the Field Museum for financial support and an award from Roosevelt University (Dean's Office), which enabled him to work on this publication in Germany with JF. We are indebted to Cäsar Claude (ZMUZ) for the loan of the type of *R. hilli*, Manuel Ruedi (MHNG) for a short-term visitor grant to JF that allowed the study of collections under his care, which includes new material of *R. ruwenzorii*, Eileen Westwig and Darrin Lunde (AMNH) for photographs of the type specimen of *R. ruwenzorii*, and John Weinstein (FMNH) for skull and noseleaf photographs of the new species. Finally, the cooperation of the ornithological community provides vital continuous support in documenting Chiropteran diversity.

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Appendix 1.

Collecting localities of *Rhinolophus ruwenzorii*, *R. hilli*, *R. willardi* sp. nov., and *R. kahuzi* sp. nov.

Rhinolophus ruwenzorii J. Eric Hill, 1942

D.R. CONGO: S-side of **Butahu [= Butawu] Valley** (cave, 7500 ft., W-slope Rwenzori Mts.) (Hill 1942; Fahr et al. 2002; Csorba et al. 2003: as "Butatu Valley"; AMNH 82394, holotype, ♀, alc. & skull, leg. 24.XII.1926); **Butembo** (1760 m, Kivu) (Hayman et al. 1966; Fahr et al. 2002; Csorba et al. 2003; IRSNB 7047, ♂, skin & skull, leg. J. Hiernaux, 16.VIII.1947); **Kibwe Lya Mikako Cave** (1500 m, Kasuo, Lubero Distr.) (Bogdanowicz 1992, Bogdanowicz & Owen 1992; Fahr et al. 2002; MRAC RG 35170, -173, -174, -206, -208, -211, RG 35216 – 219, 3 ♂♂, 4 ♀♀, 3 unsexed, leg. R. P. M. J. Celis & M. Lejeune, 28.XII.1966); **Matata Cave** (1160 m, Kibali-Ituri) (Hayman et al. 1966; Fahr et al. 2002; Csorba et al. 2003; IRSNB 7048, ♂, skull only, leg. J. Hiernaux, 10.VIII.1947); **Matupi Cave** (3500 ft., Mt Hoyo, S of Irumu, Ituri Forest) (Hayman 1960; Fahr et al. 2002; Csorba et al. 2003; BMNH 60.99 – 101, 3 ♂♂, 2 skin & skull, 1 alc., leg. A. E. Wright, 14.&16.IX.1959); **Mt Hoyo** (1200 m, Ituri Forest) (Hayman et al. 1966; Fahr et al. 2002; Csorba et al. 2003; IRSNB 7049, ♀, skull only, leg. J. Hiernaux, 10.VIII.1947); **Mt Hoyo** (Komanda) (MHNG 1873.11 – .14, 3 ♂♂, 1 ♀, alc., leg. F. Meier, 21.VIII.1976); **Pahoni** (N'Duye) (MHNG 1873.10, ♀, alc., leg. F. Meier, 6.VIII.1976).

RWANDA: **Mutura** (2200 m) (Fahr et al. 2002; MRAC 85006 M 447, -448, 2 ♂♂, alc. & skull, leg. Baeten & Janssens, 16.XII.1982).

UGANDA: **Itama Mine** (1615 m, Bwindi-Impenetrable-NP, Kigezi) (Smith & Hood 1980; Fahr et al. 2002; Csorba et al. 2003: as "Kigezi Highlands"; LACM 51750, 57772 – 777, 3 ♂♂, 4 ♀♀, 1 skin & skull, 3 alc. & skull, 3 alc., leg. A. L. Archer, 31.III.1967); **Luhizha Mine [Ruhizha wolfram mine]** (2286 m, Bwindi-Impenetrable-NP, Kigezi) (Smith & Hood 1980; Fahr et al. 2002; Csorba et al. 2003: as "Kigezi Highlands"; LACM 51747 – 749, 2 ♂♂, 1 ♀, 3 skin & skull, leg. R. Glen & A. Williams, 27.III.1967); near **Mahoma River** (cave, 6700 ft., above Ibanda, E-slope Rwenzori Mts.) (Hayman 1957; Fahr et al. 2002; Csorba et al. 2003: as "Ibanda"; BMNH 55.1187, ♀, alc. & skull, leg. G. O. Evans, 22.VIII.1952); right bank of **Mubuku River** (6900 ft., above confluence with Mahoma River, Rwenzori Mts.) (Kityo & Kerbis 1996: as "Rwenzori Mts. at 2100 m"; Fahr et al. 2002; Thorn et al. 2009; FMNH 144309 [at Makerere Univ.], ♂, skin, skel. & skull, leg. W. T. Stanley, 25.XI.1990); **Nteko Parish** (1600 m, edge of Bwindi-Impenetrable-NP, Bufumbira) (Fahr et al. 2002; Thorn et al. 2009; FMNH 160357 [exchanged], ♂, skin, skull & skel., leg. R. M. Kityo, 19.V.1997); **Nyabitaba** (2591 m, Mubuku Valley, E-slope Rwenzori Mts.) (Smith & Hood 1980; Fahr et al. 2002; Csorba et al. 2003; LACM 51751, ♂, leg. R. Glen & A. Williams, 5.VI.1967); **Nyabitaba Hut** (8750 ft., right bank of Mubuku River, below confluence with Bujuku River, Rwenzori Mts.) (Kityo & Kerbis 1996: as "Rwenzori Mts. at 2700 m"; Fahr et al. 2002; Thorn et al. 2009; FMNH 144310, ♂, alc., leg. W. T. Stanley, 11.XII.1990; FMNH 144311, -312, 2 ♂♂, 1 alc., 1 skin, skull & skel., leg. J. C. Kerbis, 19&20.IV.1991).

Rhinolophus hilli Aellen, 1973

RWANDA: **Uwinka** (P.N. de Nyungwe, 2512 m) (Aellen 1973; Fahr et al. 2002; Csorba et al. 2003: as "Cyangugu"; ZMUZ 126639, holotype, ♀, alc. & skull, leg. U. Goepel, 25.VIII.1964, F-N° 481); **Ruta Bansugera** (P.N. de Nyungwe, 1750 m) (Baeten et al. 1984; Fahr et al. 2002; MRAC 82006 M 1, ♀, leg. F. De Vree et al. 19.X.1981).

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Rhinolophus willardi sp. nov.

D.R. CONGO: **Kilicha River** (Mt Kabogo, near Kalemie, 1880 m) (FMNH 195182, ♂, alc. & skull, leg. A. Plumptre & E. A. Mulungu, 28.II.2007); **2nd camp** (Mt Kabogo, 4 km SW Talama, 1950 m) (FMNH 195082 – 084, 1 ♂, 2 ♀♀, skin & skull, leg. B. D. Marks, 14. & 16.II.2007).

Rhinolophus kahuzi sp. nov.

D.R. CONGO: **Mt Kahuzi** (Kahuzi-Biega-NP, 2560 m) (FMNH 219793, ♂, alc. & skull, leg. R. Kizungu, 28.VII.2007, F-N° JCK 5406).

Appendix 2.

Gazetteer of collecting localities (updated from Fahr et al. 2002)

D.R. CONGO:		
Kilicha River	5°06'19"S, 29°03'56"E	near Kalemie, Misotschi-Kabogo highlands, 1880 m
2nd camp	4°59'29"S, 29°04'49"E	4 km SW Talama, Misotschi-Kabogo highlands, 1950 m
Mt Kahuzi	2°12'07"S, 28°40'24"E	Kahuzi-Biega National Park, 2560 m
Butahu Valley	0°19'35"N, 29°49'20"E	W-slope Rwenzori Mts., 7500 ft. [2286 m]
Butembo	0°09'N, 29°17'E	Kivu Province, 1760 m
Kibwe Lya Mikako Cave	0°14'42"S, 29°01'E	Kasuo, Lubero Distr., 1500 m
Matata Cave	0°58'30"N, 29°40'E	Kibali-Ituri, 1160 m
Matupi Cave	1°16'12"N, 29°54'36"E	Mt Hoyo, S of Irumu, Ituri Forest, 3500 ft. [1066 m]
Mt Hoyo	1°13'N, 29°49'E	Ituri Forest, 1200 m
Pahoni [= Paoni]	1°58.5'N, 28°52.5'E	N'Duye [= Nduye], near Biasa River, NE edge of "Réserve de Faune à Okapis"
UGANDA:		
Itama Mine	0°59'S, 29°41'E	Bwindi-Impenetrable-NP, Kigezi Highlands, 1615 m
Luhizha Mine	1°01'53"S, 29°46'42"E	Bwindi-Impenetrable-NP, Kigezi Highlands, 2286 m
Mahoma River	0°21'39"N, 30°00'06"E	above Ibanda, E-slope Rwenzori Mts., 6700 ft. [2042 m]
Mubuku River	0°21'50"N, 29°59'53"E	above confluence with Mahoma River, E-slope Rwenzori Mts., 6900 ft. [2103 m]
Nteko Parish	1°02'16"S, 29°36'E	edge of Bwindi-Impenetrable-NP, Bufumbira, 1600 m
Nyabitaba (Hut)	0°21'26"N, 29°58'31"E	right bank of Mubuku River, below confluence with Bujuku River, E-slope Rwenzori Mts., 8750 ft. [2667 m]
RWANDA:		
"near Cyangugu"		Parc National de Nyungwe, 2500 m
Mutura	1°37'S, 29°23'E	2200 m
Ruta Bansugera	2°25'S, 29°10'E	Parc National de Nyungwe, 1750 m
Uwinka	2°29'S, 29°12'E	Parc National de Nyungwe, Préfecture de Cyangugu [= Shangugu], 2512 m

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Mammals, other than bats, from the Misotshi-Kabogo highlands (eastern Democratic Republic of Congo), with the description of two new species (Mammalia: Soricidae)

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Abstract. The Albertine Rift has recently been declared by Plumptre et al. (2007a) as one of Africa's biodiversity hotspots due to the high number of species and high levels of endemism. Here we report on a recent but brief survey of mammals from the Misotshi-Kabogo highlands of the eastern Democratic Republic of Congo. This represents the first effort to document the mammal community of the region. Remarkably, the collection includes at least three species of mammals new to science: two species of shrews (Soricidae) described here and one species of horse-shoe bat (Rhinolophidae, Kerbis Peterhans et al. 2013). A total of five mammal taxa are now known exclusively from this forest. One of the shrews (*Myosorex* n. sp.) which we describe here continues to fill in distributional gaps of this typically montane-restricted genus. Several of the large mammal taxa provide significant range records, especially as southern terminals for species' distribution. Together the data recorded here demonstrate the need for conserving this isolated and heretofore unrecognized reservoir of biodiversity.

Key words. Soricidae, Mammalia, Democratic Republic of Congo, Misotshi-Kabogo Highlands, Albertine Rift, endemism, new species.

INTRODUCTION

The Albertine Rift montane zone of central Africa, extending from the Blue Mountains in the north (ca. 2°N, 30°30'E) to the southern end of Lake Tanganyika (ca. 9°S, 30°30'E) has only recently been declared one of Africa's biological hot spots due to high levels of species diversity and endemism (summarized in Plumptre et al. 2007a). Although many surveys have been conducted and published on the gorilla-inhabited Virunga-Bwindi heartland, many isolated areas, especially Congolese landscapes peripheral to this heartland, have never been properly studied. Such areas include the Blue Mountains to the north and the Itombwe Massif, Misotshi-Kabogo Highlands and Marungu Plateau to the south. The Misotshi-Kabogo highlands (5°–6° S) overlook the middle of Lake Tanganyika. The last survey on vertebrates in the region was conducted by Prigogine in the 1950's (Prigogine 1960) who documented the bird community and described one species new to science, the Kabobo Apalis (*Apalis kaboboensis*). As for mammals, we are only aware of Prigogine's list (1960) of large mammals and short notes on a single squirrel and single colobus monkey both collected by Prigogine during his time there and both described as sub-specifically distinct (Verheyen 1959, 1960). Here we report on a brief survey in these highlands that provides the first records of terrestrial small mammals for the region, including two species (Soricidae) that are new to science. Although some of this information has been published already (see Plumptre et al. 2007b), these data are so important that formal publication is warranted.

MATERIALS AND METHODS

Different means were used to survey the small and large mammal communities. Small mammals were actively collected from three campsites between 28 January, 2007 and 26 February, 2007, in the Misotshi-Kabogo highlands just north of the town of Kalemie (once known as Albertville, 05° 56'S, 29° 12'E), eastern Democratic Republic of Congo. Shrew sampling was attempted using pitfall bucket lines. These consisted of a total of fifteen to seventeen 5 liter buckets individually set five meters apart. Plastic

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sheeting, ca 25 cm high, served as a drift fence over the midline of the buckets (see Voss & Emmons 1996). A pitfall line was set at each of the first two camps (68 bucket nights and 75 bucket nights respectively) but without any success. Fourteen conventional 'rodent' trap lines collected all shrews and mice. Camp one had six trap lines while camps two and three had four each. Trap number ranged from 35 to 63 traps per line. Trap lines varied in trap number and duration due to shifting camps and varying personnel availability. The majority of traps were placed on the ground. Others were set near streams and others above the ground on vines, tree limbs or fallen logs. A mixture of peanut butter and oatmeal was used as bait but occasionally fish and corn kernels were employed. All of the trap lines and pitfall lines were set within 500 meters of the respective camp site.

We used a combination of methodologies to determine which large mammal species currently occur in the Misotshi-Kabogo forest (Plumptre et al. 2007b). We interviewed hunters actively working in the forest today as well as former military who were active there during times of civil strife. These people were interviewed about which large mammal species they had seen in the forest and where they saw them. We used Kingdon's (1997) Field Guide to African Mammals to show local hunters pictures of the animals and then cross-checked their identifications by asking them about the behavior of the animal. We also asked people in villages to show us any skins of animals to cross-check the list obtained by talking to hunters. One hyrax skin and several carnivore skins were purchased from local people. A brush-tailed porcupine (*Atherurus africanus*) was snared by one of the camp staff and a black-fronted duiker (*Cephalophus nigrifrons*) was found in a snare while surveying transects (see below).

We also attempted to collect data on large mammals by walking along transects in fixed compass directions from one of eight camp sites (Plumptre et al. 2007b). Where only gallery forest existed, zigzag transects were covered to maximize the time spent in this forest type before moving towards the next patch of forest. The zigzag transects extended beyond the forest by 500 meters before returning back to the forest. In this way some sampling was made in the woodlands around the gallery forests but most of the effort was concentrated in the forests. Densities for certain species could be calculated for the forest and the surrounding 500 m of woodland from these data. Once a patch of forest had been surveyed with the zigzag transects, a walk was made following a fixed compass direction to the next patch of forest.

At each camp site a transect or reconnaissance walk was made each day following a compass direction where possible but deviating when the terrain became impassable or if in gallery forest. Much of the Misotshi-Kabogo forest consists of very steep hillsides which have been cut by fast running rivers. Many of the rivers have cliffs along their course making traversing them very difficult. We therefore used reconnaissance walk methods whenever we reached a point that was impassable and then selected a new compass direction. GPS positions were taken for any sighting of an animal or its signs (nest or dung of elephant and pigs) and also every 250 m a GPS position was taken with a description of the habitat type. This allowed us to map where teams had visited and also helped ground truth the satellite classifications.

Data collected for all specimens included the macrohabitat, sex, and reproductive condition. On the morning of capture, the following standard external measurements were taken: total length (TL), tail vertebrae length (TV), hind foot length (HF), ear length (E) and mass (WT). Head and body length (HB) is determined by subtracting TV from TL; due to damage to specimens and tails by ants, tables display HB rather than TL. Metrics posted in the Tables are for adult specimens only. For taxa represented by multiple individuals, metrics are pooled, then averaged. CR refers to crown-rump length of embryos. Voucher specimens were prepared as study skins and skeletons or were preserved in 10 % formalin. For the latter group, skulls were later extracted at the Field Museum of Natural History in Chicago and transferred to 70 % ethanol. The nature of the specimen preserved (cond) is recorded as ssk (skin, skull and skeleton), alc (alcoholic carcass), asr (alcoholic carcass with skull removed), or sko (skull and skeleton only).

Cranio-dental measurements were taken at the Field Museum of Natural History using Mitutoyo CD-6"CSX calipers to the nearest .01 mm. These include the following: CI (condylo-incisive length), GB (greatest breadth of skull), MX (breadth of the maxilla), UTR (length of the upper tooth row), HCC (height of the cranial capsule, measured in the sagittal plane), PGL (post-glenoid breadth), IO (inter-orbital breadth), MD (mandible length from the tip of the anteromost incisor to rear of the mandibular condyle), LTR (length of the lower tooth row), COR (height of the coronoid process of the mandible). Measurements are given in millimetres, body mass in grams.

Full technical names (based on the respective chapters in Wilson & Reeder 2005) for larger mammals are listed in Table 2; for the small mammal species they are given in the text.

Tissue samples were stored in the field in a saturated NaCl / EDTA buffer. Upon returning from the field, tissues were stored in an ultra-cold freezer at -70°C. In the field, animals were handled in accordance with American Society of Mammalogists guidelines (Animal Care and Use Committee 1998).

Specimens discussed herein were collected during the course of the Misotshi-Kabobo expedition (see Acknowledgements), supplementing the records of Prigogine (1960). Specimens were compared with material from the

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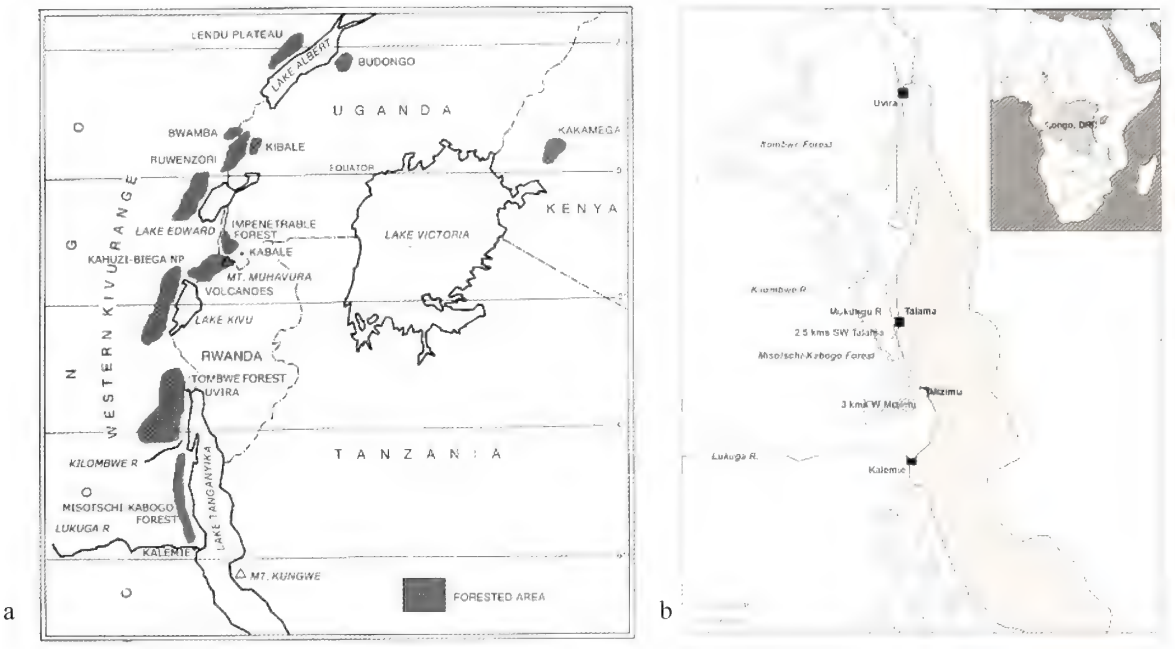

Fig. 1. Map of the Albertine Rift with the Misotshi-Kabogo highlands (a), and position of the three collecting localities (b).

following institutions: The Field Museum of Natural History, Chicago (FMNH); the United States National Museum, Washington D.C. (USNM); and the Zoologisches Forschungsmuseum Alexander Koenig, Bonn (ZFMK). All specimens are deposited at the Field Museum of Natural History, Chicago, IL. JCKP are the abbreviations for the senior author. Unless otherwise noted, taxonomy and distributional notes for all mammals are from the relevant chapters in Wilson & Reeder (2005) and Kingdon (1997).

STUDY AREA

Prigogine (1960) and Plumptre et al. (2007b) reviewed some of the biology of the area and provided notes on biogeographic boundaries. The Misotshi-Kabogo highlands are separated from the Itombwe massif to the north by a 50 km wide savannah through which crosses the Kilombwe River (Fig. 1a). This savannah constitutes a barrier for some bird species (Prigogine 1960), which must be true for some mammals as well. The absence of forest in the Kilombwe valley may be caused by the low rainfall and low humidity due to strong winds that favour herbaceous vegetation. The Marungu highlands lie to the south and are separated from the Misotshi-Kabogo highlands by the Lukuga River. Both rivers formed following the tectonic activity and uplift that created these highlands on the western shore of Lake Tanganyika. To the west, gallery forest and savannah continue for hundreds of kilometres south of the main Congo Basin Forest Block (Plumptre et al. 2007b). The Misotshi-Kabogo highlands run approximately 100 km along the escarpment above Lake Tanganyika at an estimated width of 10–20 km. On the western slopes, the forest descends the valleys as gallery forest; while in the east, it is continuous along Lake Tanganyika where it reaches 2500–2750 m (Prigogine 1960; Plumptre et al. 2007b). The forested escarpment persists uninterrupted to the lakeshore at 770 m. The main forest block is approximately 1,000 km^2 in size.

Three camps (Fig. 1b) for small mammals within the Misotshi-Kabogo forest were accessed from two different fishing villages along the Lake Tanganyika shoreline (Huhndorf & Kaleme 2007). The first camp (29 Jan–7 Feb) was established approximately 3 km west of Mizimu fishing village (5°28'45"S, 29°16'22"E) at an elevation of 1250 meters. Traps were placed in primary forest along the ridge and peripheral to a creek edge. Trap lines at this location were then relocated along the forest edge and secondary growth. This habitat can be described as transitional between lowland and montane and was close to the forest edge. The other camps were established further north and were accessed from Talama fishing village near the base of Mt. Misotshi. After climbing a steep grassy ridge, the forest was reached and camp was set within a horseshoe bend of the Mukungu River. The second camp (4°59'29"S, 29°4'49"E, 1950 m) (13 Feb 2007–17 Feb 2007) was established approximately 4 km southwest of Talama. Some traps were again set along the riverbank but mostly along a dry hill slope. Later, traps were shifted to higher ground with fewer, but larger trees

Table 1. Small terrestrial mammals of the Misotshi-Kabobo highlands. Bold = Albertine Rift endemic, SL = southern limit of distribution.

Camp		**1**	**3**	**2**
Habitat	Degraded	lowland-montane forest transition	drier forest on eastern escarpment	wet montane forest
Elevation	790 m	1250 m	1600 m	1950 m
Species				
Crocidura c.f. *dolichura*			1	
Crocidura c.f. *fuscomurina*		1		
Crocidura olivieri	1	7		
***Crocidura* n. sp.**		1		
***Myosorex* n. sp.**				1
Graphiurus murinus				1
Lophuromys aquilus	3	3	5	
Hybomys aff. *univittatus*		3		6
Hylomyscus stella		12	1	
Mus minutoides	2			
Mus triton	1			
Pelomys minor		1		
***Praomys degraaffi* SL**				2
Praomys jacksoni	4	43	15	1
Praomys sp.			1	
Rattus rattus		1		
Total specimens (# species)	11 (5)	72 (9)	23 (5)	11 (5)
Trap effort and success	Na	72/783= 9.2 %	23/630= 3.7 %	11/520= 2.1 %

and more abundant undergrowth. This habitat was typical wet montane forest. The third camp (4°59'05"S, 29°5'34"E, 1600 m) was located approximately 2.5 km southwest of Talama between 20 and 25 February, 2007. Here, traps were set along a ridge adjacent to a fern prairie, and others along large rocks and a stream along the slope of the ridge. The camp 3 habitat can be described as drier forest, located on the eastern edge of the escarpment, also close to the forest edge. Finally, eleven specimens were collected in a degraded agricultural area on the outskirts of Mizimu at 790 m (5°27'59"S, 29°17'16"E) while switching between camps (February 6–7, 2007).

RESULTS

Results of the trapping efforts for small mammals at the four camps are presented in Table 1. Trap success markedly declined with elevation. At 1250 m, trap success was 9.2 % (nine species and 783 trap nights); at 1600 m, 3.7% (five species and 630 trap nights); at 1950 m, 2.1 % (five species and 520 trap nights). Results from the large mammal surveys are presented in Table 2, along with historical data from Prigogine (1960). Metrical data on the shrews collected, including identification, date, sex, age and external measurements are presented in Table 3. and their cranio-dental measurements are presented in Table 4. For the rodents, external measurements are presented in Table 5 and select cranio-dental measurements are found in Table 6. Although each camp was not trapped with identical intensity, trap success and species diversity was highest at 1250 m. Small mammal abundance decreased with elevation although species diversity (n = 5) was similar at 1600 m and 1950 m. Of the two species new to science, one was captured at the lowest camp (*Crocidura* n. sp.) and one (*Myosorex* n. sp.) at the highest.

The following details some of the more noteworthy reproductive, taxonomic, and distributional issues posed by the specimens as well as formal descriptions of the two new species of Soricidae.

Hyracoidea

Dendrohyrax* c.f. *dorsalis. This dorsal pelt, recovered from a local hunter, cannot be definitively identified to species as diagnostic elements are missing (e.g. skull, chin and rostrum portion of the pelt) while others show mixed affinities. The dorsal white patch is long (90–100 mm) and creamy white. The midline dorsal hair is black, forms a

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Table 2. Large mammals of the Misotshi-Kabogo Highlands. PL = Plumptre et al. (2007b); PR = Prigogine (1960); FMNH, catalogue #; **SL** = demarcates southern limit of species; Albertine Rift endemics in **bold**; **S** = sight record; **F** = feces record; **N** = nest record; **H** = reported by at least 3 hunters.

Species		Common Name	FMNH	Reference
Dendrohyrax c.f. *dorsalis* (Fraser, 1855)	**SL**	Tree hyrax	195080	Skin
Loxodonta africana (Blumenbach, 1797)		African elephant		PR, H
Cercopithecus ascanius (Audebert, 1799)		Red-tailed monkey		PL (S)
Cercopithecus denti (Thomas, 1907)		Dent's mona monkey		PL (S)
Cercopithecus lhoesti (P. Sclater, 1899)	**SL**	L'Hoest's monkey		PR, PL (S)
Cercopithecus doggetti (Pocock, 1907)	**SL**	Blue monkey		PR, PL (S)
Lophocebus albigena (Gray, 1850)		Grey-cheeked mangabey		PL (S)
Papio anubis (Lesson, 1827)		Olive baboon		PL (S)
Colobus angolensis prigoginei (Verheyen, 1960)	**SL**	Angola colobus		PR, PL (S)
Pliocolobus foai oustaleti (Trouessart, 1906)		Red colobus		PR, PL (S)
Pan troglodytes (Blumenbach, 1775)		Chimpanzee		PL (N, S)
Manis gigantea (Illiger, 1815)	**SL**	Giant pangolin		PL (H)
Manis tricuspis (Rafinesque, 1821)		Tree pangolin		PL(H)
Leptailurus serval (Schreber, 1776)		Serval		PL(H)
Profelis aurata (Temminck, 1857)		Golden cat		PL (H)
Civettictis civetta (Schreber, 1776)		African Civet		PR
Genetta genetta (Linnaeus, 1758)		Common genet		PL(H)
Genetta maculata (Gray, 1830)		Rusty-spotted genet	195087–	Skin
			195088	Skin
Nandinia binotata (Gray, 1830)		2 spotted palm civet	195089	Skin
Galerella sanguinea (Rüppell, 1835)		Slender mongoose	195090	Skin
Mungos mungo (Gmelin, 1788)		Banded mongoose	195091	Skin
Crocuta crocuta (Erxleben, 1777)		Spotted hyena		PR
Canis adustus (Sundevall, 1847)		Side striped jackal		PL (H)
Mellivora capensis (Schreber, 1776)		Honey badger		PR
Hylochoerus meinertzhageni (Thomas, 1904)	**SL**	Giant forest hog		PR, PL (F)
Potamochoerus larvatus (F. Cuvier, 1822)		Bush pig		PR, PL (F)
Oreotragus oreotragus (Zimmermann, 1783)		Klipspringer		PR
Syncerus caffer (Sparrman, 1779)		Cape buffalo		PR
Tragelaphus euryceros (Ogilby, 1837)	**SL**	Bongo		PR, PL (F)
Tragelaphus scriptus ornatus (Pocock, 1900)		Bushbuck		PR, PL (S, H)
Cephalophus nigrifrons kivuensis (Lönnberg, 1919)		Black-fronted duiker		PR, PL (S, H)
Cephalophus weynsi (Thomas, 1901)		Weyn's duiker		PR, PL (H)
Philantomba monticola (Thunberg, 1789)		Blue duiker		PL (H)
Funisciurus carruthersi chrysippus (Thomas 1923)	**SL**	Carruther's mountain squirrel		PR, PL (S, H)
Funisciurus pyrropus akka (de Winton, 1895)		Fire-footed rope squirrel		PR
Heliosciurus rufobrachium ssp. (Waterhouse, 1842)		Red-legged sun squirrel		PL (H)
Heliosciurus ruwenzorii vulcanius (Thomas, 1909)	**SL**	Ruwenzori sun squirrel		PR
Paraxerus boehmi vulcanorum (Thomas, 1918)		Boehm's bush squirrel		PR
Protoxerus stangeri kabobo (Verheyen, 1959)	**SL**	Giant forest squirel		PR
Atherurus africanus (Gray, 1842)		Brush tailed porcupine	195178	Skull, skin

sort of dorsal crest and is quite long (60–80 mm in front of the dorsal white patch, 45–65 mm behind it), similar to *Dendrohyrax dorsalis sylvestris* skins from Ghana, West Africa in the collections at the FMNH. If confirmed as *D. dorsalis*, this would prove to represent the SE terminus of the species' distribution.

Proboscidea

Loxodonta africana. Elephants no longer occur in the forest but occasional crop raiders are reported. Prigogine (1960) stated that in the 1950's elephants of small size (*Loxodonta cyclotis*?) were known from the area.

Primates

Cercopithecus l'hoesti. This Albertine Rift endemic recorded here and before by Prigogine (1960) reaches its southern limit in these highlands.

Cercopithecus doggetti. Current taxonomy recognizes this taxon as a distinct species, adding it to the expanding list of Albertine Rift endemics. It also reaches its southern limit here.

Colobus angolensis prigoginei. This taxon, notable by its all-white tail, is only known from these highlands. It is endangered as only one sight record of this taxon was made during the recent survey, and none were seen along transects.

Pan troglodytes. Surprisingly, chimpanzees were not discussed or listed by Prigogine (1960). Chimpanzees reach their southern limit on the Marungu highlands to the south where Noack (1887) described a population under the name *marungensis.* However, our aerial reconnaissance shows grassy highlands with only traces of gallery forest remaining there. Details on our chimpanzee surveys and estimates can be found in Plumptre et al. (2007b). Their surveys documented nests suggesting a density of 1.22 chimpanzees per km^2 in the Misotshi-Kabogo Highlands. With a forest block of approximately 804 km^2, this translates into an estimated population of 977 ± 252. It appears that local taboos against hunting chimpanzees in the forest highlands have been effective in their conservation.

Pholidota

Manis gigantea. The Misotshi-Kabogo highlands appear to represent the southern terminus for this forest dependent species.

Carnivora

Genetta maculata. Two skins (FMNH 195087–195088), one of a juvenile. Both skins have tails with black tips and with dorsal crests starting midway down the torso, as described in Kingdon (1977). The spots are not in discrete linear rows.

Artiodactyla

Hylochoerus meinertzhageni. This record represents the southern limit for this spectacular suid. As it is in Kenya, the species was only found at high elevation (2500 m). Prigogine (1960) also confirmed this high elevation restriction (2400 m) in the Misotshi-Kabogo highlands.

Tragelaphus eurycerus. As for the previous record, this also represents the southern limit for a magnificent animal (Ralls 1978). As for Prigogine (1960), our record is from high elevation at 2500 m, sharing a distinct biotope with *Hylochoerus meinertzhageni* in areas at the periphery of its range (Ralls 1978). Given the shared elevation range of this population with the montane Kenyan population, the possibility of taxonomic similarities between these populations should be investigated.

Soricomorpha

Crocidura c.f. ***fuscomurina*** (Heuglin,1865). A single representative (FMNH 195071) was taken in a Museum Special trap. As it was prepared as a skeleton, no details of the pelage coloration or caudal bristles are available. The identification of the specimen remains tentative. Sex was not determined. In size, it ranks as one of the smaller *Crocidura* known for the region (4.8 g, CI=17.3 mm). Braincase is small in both height (HCC 4.1 mm) and breadth (GB 7.6 mm); maxilla is narrow (MX 5.3 mm), dentition light. First upper unicuspid by far the largest, 2–3 times larger than second and third, both of which are sub-equal in size. Cingula of unicuspids well developed; parastyle reduced and not projecting; upper P4 vacuous posteriorly; upper M3 short (reduced). Lower incisor smooth and without denticulations; lower M3 simple and without talonid basin.

This specimen approximates *Crocidura ansellorum* (Hutterer & Dippenaar, 1987) from Northern Zambia in many cranio-dental dimensions (CI=17.3 mm vs. *C. ansellorum* with CI of 16.8–17.7 mm) but its small brain case (GB=7.6 mm, HBC=4.1 mm) distinguishes it (*Crocidura ansellorum*, GB=8–8.4 mm, HBC 4.6–4.7 mm). All cranial measurements fall within the ranges of members of the *Crocidura fuscomurina* group, as reviewed in Hutterer (1983) who described this as a savannah species; here it was captured at the forest edge in a transitional brushy area near a grassy hillside.

Crocidura c.f. ***dolichura*** Peters, 1876 (FMNH 195070).This taxon is recognized by its delicate dentition, three upper unicuspids with heavy cingula, and a naked tail that is significantly longer then HB. Originally described from Cameroon, its range extends from Nigeria in the west across the Congo basin into western Uganda, Burundi and Rwanda in the east (Hutterer 2005; FMNH specimens). Variation within the group is not trivial and the taxon, as currently recognized, is in need of revision.

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Adult male, testes 3x2 mm. Teeth minimally worn. Captured in museum special trap; skull broken at capture. Dorsal pelage with silvery grey base (70 % of hair length), followed by light brown (15 %) and tipped with darker brown (15 %) yielding an appearance that is dark grey washed with brown. Belly fur silvery grey throughout. Tail length ca. 130 % of HB. Lower first incisor with two subtle denticulations. Maxillary unicuspids with heavy cingula. First upper unicuspid the largest, twice as large as second, third unicuspid the next largest, 50 % larger than second. These proportions differ from those evident in Brosset et al.'s (1965) figure of the type specimen of *Crocidura dolichura* where the second and third unicuspids are sub-equal in size, and only slightly smaller than the first. Upper P4 lightly built, vacuous posteriorly. Upper M3 well developed. Dental characteristics similar to FMNH 162198 from Gabon, but differing in its longer tail (132 % of HB compared with 111 %) and more grey-like dorsal pelage (vs. cinnamon brown).

Crocidura olivieri (Lesson, 1827) (FMNH 195072–195078, 195180).These ubiquitous 'giant shrews' of forested sub-Saharan Africa were quite common at lower elevations of the Misotshi-Kabogo Highlands where they represented 8/83 (9.6 %) of snap trap captures at camp 1 (Table 1). Frequency of capture at Camp 1 was 7/783 (.009). They were readily caught with conventional break-back traps baited with peanut butter and oatmeal. However, not a single specimen was caught at 1600 m and 1950 m (34 specimens captured during 1150 trap nights). Five of the 8 specimens collected were adult, four of seven sexable specimens were female, two of three adult females were pregnant, and male testes size averaged 7x3.5 mm.

Using the sub-species recognized by Hutterer (2005) and the key of Dollman (1915a), these specimens need comparison with *C. olivieri kivu* (Osgood, 1910) described from Lake Kivu to the north, and *C. olivieri zuleika* (Dollman, 1915b) described from southern Zimbabwe. In his key, and with access to the relevant type material at the British Museum (Natural History), Dollman (1915a) distinguished these taxa based on dorsal pelage, the former being a 'dark chocolate brown' while the latter is 'a dull coffee-brown'. Our series are more referable to the 'dull coffee' type but the dorsal pelage has grey bases, tipped with coffee brown. In any case, we realize that this character must be locally plastic and cannot have great taxonomic weight. However, in his description, Dollman (1915b) also distinguishes *C. olivieri zuleika* from *C. olivieri kivu* based on the larger teeth of the former. However, the UTR of our series (adults only) averages 13.6 mm compared to 14.8 mm for the type of *C. o. zuleika*. Therefore, we are unable to associate this series with a currently recognized sub-species.

***Crocidura lwiroensis* n. sp.** Kerbis Peterhans & Hutterer.
(Fig. 2; Tables 3, 4); The Misotshi-Kabogo Crocidura.

Holotype. FMNH 195181, original number MHH 828 (Fig. 2). Adult female with swollen mammae (3+3). Basioccipital suture closed. Dentition with moderate wear. Left leg (tibia) broken post-mortem. Prepared as an alcoholic carcass with skull removed (asr). Captured in a 'museum special' mouse trap with peanut butter and oatmeal as bait. Collected on 06 February, 2007 by B. Ndara.

Type Locality. Approximately 45 km NE of Kalemie and 3 km W of the village of Mizimu above the western shore of Lake Tanganyika, Katanga Province, eastern Democratic Republic of Congo (29°16'22"E 5°28'45"S, 1250 m).

Etymology. The specific epithet honors the biological research team based at Lwiro (Centre National de Recherche Scientifique), the biological research station 25 km north of Bukavu, South Kivu, eastern Democratic Republic of Congo. This group has persisted in their academic inquiries despite difficult socio-economic conditions and civil strife over the past 15 years. Their academic accomplishments have been inspiring and this represents but one of the team's impressive findings.

Diagnosis. *Crocidura lwiroensis* is distinguished from other members of the genus both externally and cranio-dentally. Externally, it features very small body small size (5.6 g) and a tail that is nearly naked with only 8–10 bristles on the basal 20 %. Dark grey above, slightly lighter below. Skull very small (CI=18.26 mm). Parastyle of P4 long, heavy and broad, projecting forward, and providing a medial pocket for the large third unicuspid. Third unicuspid large, 40 % larger than second; 30 % of its length eclipsed by the upper P4.

Description. External measurements are presented in Table 1. Pelage dark grey in appearance. Dorsal fur short (2.7 mm) with dark grey roots tipped with drab brown. Occasional silver ticks to dorsum. Belly fur appearing slightly more light grey as the tips are only faintly brown. Six swollen inguinal teats. The tail is naked except for 8-10 bristle hairs located on the bottom 20 % of the tail. Pes sparsely haired with dark hairs, foot scales darker laterally giving an impression of a darker colour on outside aspect. Foot 11.5 mm with claw, 10.2 mm without.

Cranio-dental measurements are presented in Table 2. Maxilla short (UTR 7.9 mm) and broad (6.04 mm). Infra-orbital bridge narrow (0.69 mm; figured in Meester 1963). First upper incisor lightly built. Cingulum on upper unicuspids very heavy, especially on first and third. The third upper unicuspid is exceptionally large, 25 % larger than UP2, and projects posteriorly so that fully 1/3

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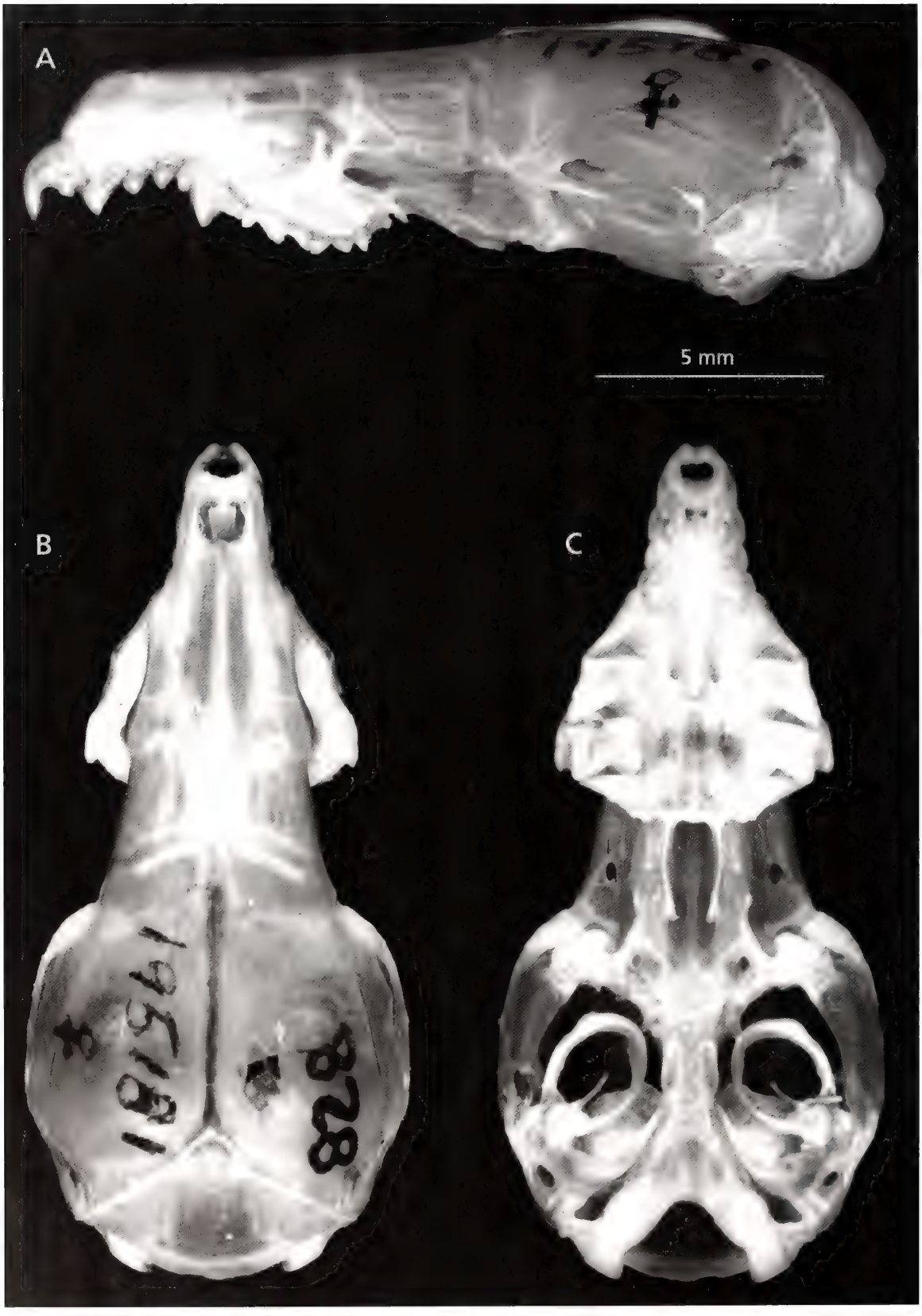

Fig. 2. *Crocidura lwiroensis* n. sp., holotype FMNH 195181 in dorsal, ventral, and lateral view. Scale is 5 mm.

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of its length is overlapping with the medial aspect of the upper P4. Parastyle of upper P4 prominent. Upper P4 fairly weak and vacuous. Upper M3 modest in dimensions (0.62 x 1.35 mm). Lower incisor with slight denticulation. Lower M3 simple and without talonid.

Comparisons. The small size (CI <19 mm) and nearly naked tail aligns the new species with a small subset of members of the genus (e.g. *C. niobe*, *C. pitmani*) with tail pilosity at or below 50 %. The new species resembles *Crocidura niobe* due its small size, nearly naked tail and heavy unicuspids with prominent cingulum. However, it is significantly smaller in all cranio-dental dimensions than *C. niobe* (CI 18.2 vs 20.0 mm). All maxillary unicuspids more rectangular than those of *C. niobe* which are broader than they are long. Upper P4 more slightly built than the stocky form seen in *C. niobe*, especially the talonid. Anterior palatal foramina positioned across from the anterior half of the M1 in the new form compared with their positioning across the posterior half in *C. niobe*. Lower incisor relatively smooth compared with the denticulate appearance of *C. niobe*. *C kivuana* is also much larger (CI>20 mm) and is void of tail bristles. The new species is approached by *Crocidura pitmani* (Barclay, 1932) in cranio-dental dimensions but *C. lwiroensis* has a more narrow braincase (GB: 3.92 vs. 4.4 mm), and a much larger third unicuspid that overlaps with the upper P4. *C. lwiroenesis* has shorter fur (2.7 vs. 4–5 mm) and a shorter and virtually naked tail with very few bristle hairs (vs. hairs over the basal 50 % in *C. pitmani*).

In cranial dimensions, *Crocidura hildegardeae* ssp. is comparable. However, the new form has long bristle hairs on only 20 % of its length, whereas in *C. hildegardeae* this ranges from 50–75 %. The new species also differs from it in its darker and more unicolored pelage above and below, vs. the brown/grey bicoloured pattern of *C. hildegardeae*. The skull in the new form is shorter and heavier as reflected in the more rounded braincase (vs. the oval form found in *C. hildegardeae*) and broader maxillary region (compared to the length of the upper tooth row). Upper P3 much larger compared to P2 in *C. lwiroensis* compared to the subequal form in *C. hildegardeae*. One variety of *C. hildegardeae* (*C. h. lutreola* Heller, 1912) also has a much larger upper third premolar but does not overlap greatly with the upper P4 as the new form. It is further distinguished by its more bristled tail, narrower maxilla and broader infra-orbital bridge. The last two unicuspids are larger and more elongate in *C. lwiroensis* than the more squared/rounded form seen in *C. hildegardeae*. The last upper unicuspid in *C. lwiroensis* protrudes posteriorly and contrasts the squared-off form in *C. hildegardeae*. As noted above, the upper P3/P4 complex of *C. lwiroensis* is unique among these small *Crocidura* ssp.

More distant comparisons include forms from West Africa, Ethiopia, and northern Kenya. *C. crossei* from Nigeria has a longer (51 vs. 45 mm) and more bristled tail ('evenly scattered throughout except at the extreme tip'; Thomas 1895). It is more unicolored, being slate grey above and below (Hutterer & Happold 1983). It also has a longer skull (19.3 vs. 18.26) and upper tooth row (8.3 vs. 7.91) whilst having a more narrow maxilla (5.6 vs. 6.04). The Ethiopian *C. harrenna* (Hutterer & Yalden, 1990, Hutterer, pers. obs.) is larger (mass 8.5 vs. 5.6 g) with higher pilosity of the tail (80 % vs. 20 %), a longer skull (19 vs. 18.26 mm), and a broader braincase (9.2 vs. 8.42 mm) while having a narrower maxilla (5.6 vs. 6.04 mm) (Hutterer & Yalden 1990). Likewise, *C. phaeura* Osgood, 1936, also from Ethiopia, has a darker pelage (blackish brown to dark brown) with a longer foot (15 mm). Cranio-dental measurements are longer than the new species described here: CI (19.3–21.1 mm) and UTR of 8.8, with a longer upper M3 (0.81–0.88 mm). Finally, *C. macowi*, known only from Mt. Nyiro in northern Kenya, is more dark brown (and with more sharp contrast to the grey of the belly). *C. macowi* also has a longer tail (up to 58 mm), longer skull (19.7 mm), and a longer, yet more narrow maxilla, and with a broader interorbital region (4.6 mm). The third upper unicuspid and its medial eclipse of the parastyle of the upper P4 are again distinctive in the new form.

Ecology and accompanying small mammal community. The new species of *Crocidura* was captured along a creek in primary forest at 1250 m. The small mammals with which it was caught include the following: *Crocidura olivieri* (n = 7), *Crocidura* c.f. *fuscomurina* ssp. (n = 1), *Lophuromys aquilus* (n = 3), *Hybomys* aff. *univittatus* (n = 3), *Hylomyscus stella* (n = 12), *Pelomys minor* (n = 1), *Praomys jacksoni* (n = 43), and *Rattus rattus* (n = 1).

***Myosorex kabogoensis* n. sp**. Kerbis Peterhans & Hutterer.
(Figs 3, 4; Tables 3, 4); The Misotshi-Kabogo Myosorex.

Holotype. FMNH 195079, original number MHH 840. Adult male, testes not convoluted, 2 x 1 mm. Basioccipital suture closed. Dentition with very little wear. Prepared as a skin with skull and skeleton (ssk). Captured in a 'museum special' mouse trap with peanut butter and oatmeal as bait. Collected on 15 February, 2007 by P. Kaleme.

Type locality. Mt. Misotshi area, 4 km SW of the village of Talama, above the western shore of Lake Tanganyika, South Kivu Province, eastern Democratic Republic of Congo (29°4'49"E 4°59'29"S, 1950 m).

Etymology. Named for the montane forest in which it was found.

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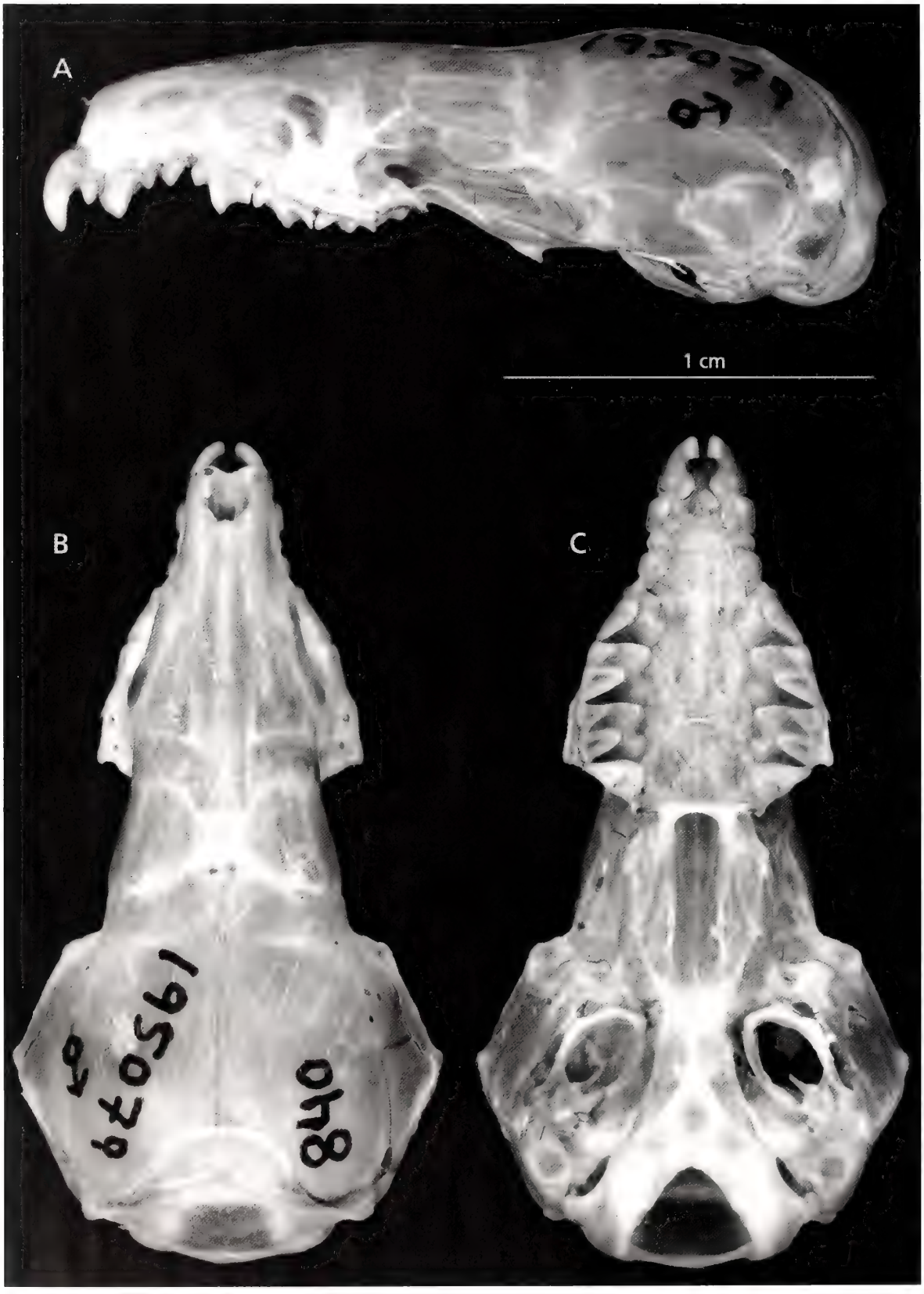

Fig. 3. *Myosorex kabogoensis* n. sp., holotype FMNH 195071 in dorsal, ventral, and lateral view. Scale is 10 mm.

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Fig. 4. *Myosorex kabogoensis* n.sp., holotype FMNH 195071, view of palate and upper dentition. Scale is 5 mm.

Table 3. External measurements of Misotshi-Kabogo Soricidae.

FMNH	Species	Date	Cond	Sex	Age	TOT	TL	HF	E	WT	Tail bristles
N=5 +	*Crocidura olivieri*	var.	var.	2 m 3 f	Ad	201	74	20	11	40.5	56 %
195071	*Crocidura* c.f. *fuscomurina*	Feb 4 2007	sko	?	Ad	113	49	11	8	4.8	na
195181	*Crocidura lwiroensis*	Feb 6 2007	asr	F	Ad	110	45	11.5	8	5.6	20 %
195079	*Myosorex kabogoensis*	Feb 15 2007	ssk	M	Ad	117	28	14	5	12	0 %
195070	*Crocidura* c.f. *dolichura*	Feb 15 2007	ssk	M	Ad	167	95	15	11	7.8	0 %

* specimen eaten in trap, re-measured in Chicago
\+ mean of the five adult specimens (195072, 195073, 195074, 195076, 195077: 2 m, 3 f)

Diagnosis. Among members of the genus, *Myosorex kabogoensis* is easily diagnosed both externally and cranio-dentally. Externally, it has an exceptionally short tail in relation to head and body length (28/89=31.5 %). The pelage is very dark slate blue/grey above and below, the individual hairs unicolored to their base. Braincase broad but short. The maxilla is particularly broad, both absolutely and in relation to the breadth of the braincase. Upper 4th unicuspid very small (1/6 the size of the 3rd), lies within the toothrow and is visible in lateral view. Upper 3rd unicuspid, ¾ the size of the 1st. Upper M3 proportionately large. Lower P2 not visible in lateral view. Mandibular corpus of moderate depth.

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Table 4. Cranio-dental measurements of Misotshi-Kabogo Soricidae.

FMNH	Species	CI	GB	MX	UTR	HCC	PGL	IO	MD	LTR	COR
N=5 +	*Crocidura olivieri*	29.8	12.1	9.6	13.6	6.7	8.4	5.5	19.0	12.3	7.85
195071	*Crocidura fuscomurina*	17.3	7.6	5.32	7.37	4.1	5.0	3.63	10.22	6.72	4.09
195181	*Crocidura lwiroensis*	18.26	8.42	6.04	7.91	4.75	6.09	3.92	11.11	7.31	4.32
195079	*Myosorex kabogoensis*	21.83	11.54	7.18	9.75	6.04	7.33	4.97	13.9	8.72	5.62
195070	*Crocidura* c.f. *dolichura*	^	^	5.53	8.04	^	5.95	4.02	11.17	7.27	4.13

^ skull broken

Description. Pelage dark slate grey, hairs unicolored to their base. Color identical above and below. Tail very dark above and below; extremely short (28 mm), only 31.5 % of head and body length. Foreclaws long, longest 3.15 mm (III), hindclaws shorter, longest 2.4 mm (III). Long dark hairs (1.4 mm) clothing dorsum of pes and manus (see Table 1).

Braincase broad but short (as reflected in the antero-lateral length of the hexagon), fitting well within the range of broad-headed *Myosorex* (GB/CI=>0.5, Table 2, see Kerbis Peterhans et al. (2010). Maxilla broad. Interorbital region bugling in ventral view. Narrow anterior opening (ca. 30 degrees) to the combined foramen opticum, rotundum and lacerum anterius (Meester, 1963). The foramen magnum narrow and oval-shaped.

Upper unicuspids broad. Upper U4 lies within the tooth row and is visible in lateral view (Fig. 4). Upper P4 heavily built without expansive posterior concavity. Upper M3 large (long). Lower incisor with two clear denticulations. Lower unicuspids large. Only one lower P2 present (or at least visible in medial view). Medial articular facet of the mandibular condyle short and straight. Lower M3 long and narrow.

Comparisons. Cranially, the new *Myosorex* aligns with the broad-skulled forms of *Myosorex* (GB/CI=>0.5: *M. blarina, M. babaulti, M. bururiensis, M. geata, M. kihaulei, M. okuensis, M. rumpi, and M. zinki* (see Kerbis Peterhans et al., 2010). Its maxillary and braincase breadth (GB/CI=.529) and broad inter-orbital region distinguish it from the more narrow-headed forms (GB/CI<0.5: *M. cafer, M. eisentrauti, M. gnoskei, M. longicaudatus, M. jejei, M. schalleri, M. sclateri, M. tenuis, M. varius*).

The West African taxa, *M. rumpi* and *M. okuensis* are both only known from a single plateau or mountain peak 2000 miles to the west. *M. rumpi* is substantially larger, CI>23.0 mm, and with a proportionately narrower maxilla (max/GB: .587 vs. .622 in *M. kabogoensis*). *M. okuensis* possesses a much narrower maxilla in absolute breadth (6.72 mm vs. 7.18 mm). *M. zinki* has a much

Table 5. External measurements of adult Rodentia.

Species	FMNH	Sex F, M	Age	HB	TV	HF	WT
Graphiurus murinus	195179	F	ya	95	70	18	19
Lophuromys aquilus	means	7F, 2M	ad	126	—	21	59
Hybomys c.f. *univittatus*	means	2F, 4M	ad	128.5	111	29.7	54
Hylomyscus stella	means	4F, 5M	ad		130	18	21
Mus minutoides	195116	F	ad	71.5	40.5	12	9
Mus minutoides	195117	F	yad				
Mus triton	195118	F	ad	88	55	14	20
Pelomys minor	195187	M	ad	124	122	27	51
Praomys degraaffi	195120	M	ad	109	126	23.5	30.5
Praomys degraaffi	195122	F	-	101	123	23	26
Praomys jacksoni	means	3F	yad	147.7	105.3	23.7	36.3
Praomys jacksoni	means	7F	ad	141	113.7	24	40.5
Praomys jacksoni	means	4M	yad	134	101	23.7	31
Praomys jacksoni	means	6M	ad	149	118	24.2	50.2
Rattus rattus	195177	M	juv	133	152	31	69
Atherurus africanus	195178	F	ad	475	165	75	na

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Table 6. Select cranio-dental measurements of adult Rodentia.

Species	FMNH	Sex F,M	Age	CI	IO	BC	UTR
Graphiurus murinus	195179	F		23.6	4.4	13.2	3.1
Lophuromys aquilus	means	3F		28.5	6.3	12.8	5.0
Hybomys c.f. *univittatus*	means	3F, 4M		29.5	5.7	14.3	5.2
Hylomyscus stella	means	3F, 5M		23.6	4.6	11.4	3.8
Mus minutoides	195116	F		17.5	3.4	8.8	3
Mus minutoides	195117	F		17.6	3.3	8.7	3.2
Mus triton	195118	F		20.9	3.9	9.9	3.5
Pelomys minor	195187	M		29.0	4.6	13.5	5.3
Praomys degraaffi	195120	M	ya	27.25	4.75	12.6	4.95
Praomys degraaffi	195122	F	ya	25.8	4.9	11.9	4.45
Praomys jacksoni	means	3F	ya	27.7	4.8	12.1	4.5
Praomys jacksoni	means	5F	ad	27.9	4.7	12.2	4.8
Praomys jacksoni	means	5M	ya	26.4	4.7	11.7	4.6
Praomys jacksoni	means	15M	ad	29.2	5	12.4	4.8
Rattus rattus	195177	M		32.1	4.9	15.2	6.7
Atherurus africanus	195178	F		86.2	24.8	32.3	17.8

onger skull and narrower maxillae (22.8 mm and 6.5 mm vs. 21.83 mm and 7.18 mm) and is only known from Mt. Kilimanjaro.

Although this species is exceeded in breadth by several others, including neighboring *M. bururiensis*, *M. blarina* and *M. babaulti*, it has the hexagonal 'gestalt' and metrics of the more broad-skulled group. The braincase is short and smaller overall than these three. In ventral view, the interorbital region is convex and bulging compared to the parallel-sided or often concave-sided *M. babaulti, M. blarina* and *M. bururiensis*. Narrow anterior opening (ca. 30 degrees) to the combined foramen opticum, rotundum and lacerum anterius (Meester 1963) compared with ca. 40–45 degrees in *M. babaulti*. Only slightly narrower than that seen in *M. bururiensis*. The foramen magnum is more narrow and oval-shaped than either.

Upper unicuspids less broad than those seen in *M. bururiensis* but similar in their proportions. The breadth and size of the upper unicuspids are comparable to those of *M. babaulti* and *M. blarina* but unlike *M. babaulti*, the upper 4th unicuspid is visible in lateral view. This is because it lies within the tooth row and is not medially displaced and to a lesser extent, the parastyle of the following upper P4 does not protrude forward. Upper M3 much larger and longer than that of *M. blarina*.

The mandibular corpus, articular facet of the mandibular condyle and the lower unicuspids of *M. kabogoensis* are much less robust than in *M. bururiensis*. The lower unicuspids are comparable in size to *M. babaulti*. The lower M3 is clearly more narrow, especially the talonid. The medial facet of the mandibular condyle is very short and straight as opposed to the longer and more concave condition seen in *M. babaulti*.

The dark slate-grey of the pelage is unicolored and without the tricolored mottling seen in certain members of the genus (e.g. *M. gnoskei*, *M. geata* (?) and the S African *M. cafer* and *M. varius*). This also contrasts with the bicolored pelage (basal 80 % slate grey, distal 20 % dark brown) seen in the more northern forms (*M. blarina*, *M. bururiensis* and *M. babaulti)*. Externally, its short tail, in relation to head and body length is met only by *M. bururiensis* (Table 2 in Hutterer et al. 2001; Table 2).

Ecology and the small mammal community. The new species was captured along a dry hill slope in primary forest where a few large trees emerge from dense and shrubby undergrowth (1950–2000 m). It had rained the previous early morning, ca 24 hours prior to capture. Rodents collected in the same general area include *Graphiurus murinus* (n = 1), *Hybomys univittatus* (n = 6), *Praomys degraaffi* (n = 2), and *Praomys jacksoni* (n = 1).

Rodentia

Funisciurus carruthersi chrysippus. Our observations and Prigogine (1960) mark the southernmost occurrence known for this Albertine Rift endemic.

Heliosciurus ruwenzorii vulcanius. The record from Prigogine (1960) marks the most southerly record known for this Albertine Rift endemic.

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Protoxerus stangeri kabobo. This giant squirrel is widespread in tropical Africa and is an indicator of good forest. This subspecies is recognized as distinct and is confined to the Kabogo-Misotshi highlands.

Graphiurus murinus (Desmarest, 1822). The sole specimen (FMNH 195179), a young-adult with first premolar in early wear, is a nulliparous female and was prepared as a skin with skull and skeleton. We refer this species to *Graphiurus murinus* due to its size (external and craniodental), dark coloration towards the rear of the manus and pes and the lack of a white tip to the tail.

Lophuromys aquilus True, 1892. In addition to *Praomys jacksoni*, members of this species complex are typically the most abundant taxon in east African forests. They were not a dominant component of the lower two camps (7/94=7.4 %) and were not documented at 1950 m. Nine of the ten captures were adult. The sex ratio was seven females and three males. Three of the five females inspected were pregnant (one each with two, three and four embryos) with CR ranging from 5–13mm. Testes from a single male measured 7 x 12 mm.

Hybomys aff. ***univittatus*** (Peters, 1876). As is typical for this genus, several specimens were captured near streams within forest. Six of the nine captures were adult. The overall sex ratio was four females and five males. Two of the four females inspected were pregnant (one with two embryos, the other with three) with CR ranging from 8–20. Testes of adult males ranged from 7 x 13 mm to 10 x 16 mm.

These specimens are more comparable to *Hybomys univittatus* than to *Hybomys lunaris*, the only two taxa alluded to in eastern DR Congo. As discussed in the original description (Thomas 1906) and more recently by Musser & Carleton (2005), *H. lunaris* is lightly built compared to *H. univittatus*. Comparisons of true *Hybomys univittatus* with topotypes of *Hybomys lunaris* at Field Museum confirm this. The greatest skull length (33.0–35.1 mm) of the Kabogo series falls within the range of *H. univittatus* (33.5–35.6 mm = 1 standard deviation). These are significantly larger than the *H. lunaris* series at Field Museum (31.25–32.48 mm). The dentition of the Kabogo series is intermediate: UTR (5.05–5.35 mm) and M^1 breadth (1.73–1.85 mm) compared with *Hybomys lunaris* (4.74–5.08 mm and 1.61–1.7 mm) and *Hybomys univittatus* (5.66-6.1 mm and 1.87–1.99 mm = 1 standard deviation).

Hylomyscus stella Thomas, 1911. This species is typical in lowland forest of the eastern Congo basin. Ten of the 12 aged specimens were adult. The sex ratio was seven females and six males. One of the four females inspected was pregnant with two embryos, with a CR of 3 mm. Testes of adult males measured 6 x 12 mm. The absence of members of the *Hylomyscus denniae* group (Carleton et al. 2006) in an Albertine Rift montane context is curious. Evidently, *Hylomyscus vulcanorum* reaches its current southern extent on the Itombwe Plateau, just to the north (Demos, unpublished data). Since these highlands extend beyond 2700 m, we cannot explain that members of the *Hylomyscus denniae* complex were victims of the last interglacial, ca. 12,000 years before present.

Mus musculoides Temminck, 1853. Two specimens were captured in tall grass near the village of Mizumu on the shore of Lake Tanganyika. One female was not pregnant but displayed six large teats while the other was pregnant with two embryos (CR 12x17).

Mus triton Thomas, 1909. One specimen caught in tall grass near the village of Mizumu on the shore of Lake Tanganyika. The adult female, multiparous with six teats, was pregnant with three embryos with a CR of 20 mm.

Pelomys minor Cabrera & Ruxton, 1926. A single adult, scrotal male (FMNH 195187) was taken at the forest edge along the ridge slope.

Praomys degraaffi Van der Straeten & Kerbis Peterhans, 1999. This is the second published record for this Albertine Rift endemic in DRC. FMNH has many specimens of this taxon from Mt. Tshiabirimu, Kahuzi-Biega NP, and the Itombwe Forest. The female, FMNH 195122, displays the charcoal pelage and 8 teats characteristic of the taxon while the male, FMNH 195121 shows the charcoal pelage and long and broad incisive foramina characteristic of the species. Notably, both are recorded at the highest camp (1950m) whereas 62/63 members of *Praomys jacksoni* were found at lower elevations (Table 1). This pattern of altitudinal displacement was discussed in the original description of the species (Van der Straeten & Kerbis Peterhans 1999).

Praomys jacksoni de Winton, 1897. As is typical in much of forested eastern Africa, this is by far the most abundant murid (63/104=61 %) from the surveys. It comprised over 50 % of all captures except for the highest camp where its frequency dropped to 10 % (1/10). It is distinguished from the previous species by its brown vs. black pelage, additional accessory plantar tubercles, and shorter, more narrow incisive foramina. The overall sex ratio for this species was 26 f to 34 m. Forty one out of 61 specimens were adult. Juvenile sex distribution was skewed towards females (13/20). However, this seemingly reversed in adulthood with adult males composing 27 of 40 individuals. Testes size in adult males averaged 9x15 (n=19). Three of seven adult females inspected were pregnant with embryos numbering 2 (CR 20), 3 (CR 20) and 4 (CR 14).

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There appears to be no evidence of sexual dimorphism (Table 6).

Rattus rattus Linnaeus, 1758. The recovery of this specimen (FMNH 195177) is surprising as a forest find. An adult scrotal male with testes 13x7 mm was caught in the same trap line as *Crocidura lwiroensis*.

Atherurus africanus. One female (FMNH 195178), uterus enlarged, lactating from two axial mammae, was snared by a camp attendant in primary forest.

DISCUSSION AND CONCLUSION

These discoveries, over the course of a very short period in the field (2 ½ weeks), highlight the importance of surveying undocumented African habitats, particularly isolated montane habitats within the Albertine Rift. The Misotshi-Kabogo highlands represent a particularly important montane forest block as it lies to the south of the main Kivu Highlands (Kahuzi-Itombwe) and is thought to have been long-isolated.

The two new species described here and a new horseshoe bat (Kerbis Peterhans et al. 2013) bring to five the number of unique mammal taxa known from these highlands. It is probable that further new species will be discovered here given the brevity of the 2007 field survey. Further, the one unique primate (*Colobus angolensis prigoginei*) is severely threatened with extinction despite a healthy forest cover. A total of 11 mammal species reach their southern range terminus on the Misotshi-Kabogo Highlands (Tables 1 and 2). These include such remarkable members of the megafauna as the giant forest hog (*Hylochoerus meinertzhageni*) and the bongo (*Tragelaphus euryceros*). The next montane system to the south in the Albertine Rift chain is the Marungu Highlands. Aerial reconnaissance by our team indicated that there is no remaining forest block here. We cannot claim that the barren Marungu Highlands have been deforested by anthropogenic activity or whether it has been in this state throughout historical times. What is clear is that the Misotshi-Kabogo Highlands are a critical montane system at the SE corner of the Congo forest block and provides the southern limit for many endemic Albertine Rift taxa. At present this montane forest has no formal protection; there is a need to establish a protected area here if these recently discovered new species are to be maintained.

These new discoveries indicate how much there is yet to learn of African biodiversity, especially within montane environments. Montane communities contain reservoirs of biodiversity that are inherently isolated. Their exploration must be placed at the forefront of survey and conservation efforts. Only 13 years ago (Myers et al. 2000), it was claimed that the Albertine Rift did not warrant recognition as an international *Hot Spot* due to inadequate knowledge. We have started filling in this void by describing 8 small mammal species from the Albertine Rift since 1999 that are new to science (Van der Straeten & Kerbis Peterhans 1999; Kerbis Peterhans & Hutterer 2009; Kerbis Peterhans et al. 2010; Kerbis Peterhans et al. 2013, this paper). Continued field surveys and collections, such as the one reported on here, are crucial to this effort. Interest from non-government organizations (NGO's) has provided various groups with the resources to begin surveys of the unexplored pockets within the ecoregion. Discoveries of rare or species new to science have the potential to serve as flagship species for areas that lack formal protection. Finally, the fairly rapid turnover from field survey to published manuscript further illustrates that the oft-ignored small mammal community should be fundamental in biodiversity surveys.

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Appendix

Specimens examined for comparison

Dendrohyrax dorsalis sylvestris (Temminck, 1853). Gabon (5): FMNH 54448, 54679–681, 62767.

Crocidura dolichura (Peters, 1876). Gabon (1): FMNH 162198.

Crocidura fuscomurina (Heuglin, 1865). Angola, Humpata, ZFMK 89.48; Kenya, Nairobi, Embakasi Plains, ZFMK 85.65; FMNH 17719, 17723; Sudan, FMNH 86028.

Crocidura hildegardeae altae (Heller, 1912). Kenya: Mt Garguez, North Creek, 6000'–6500', USNM 182426, 182429, 182430.

Crocidura hildegardeae hildegardeae (Thomas, 1904). Democratic Republic of Congo: Mbayu, ZFMK 68.505, Buhenge, ZFMK 89-450, Bukarabwa, ZFMK 89–455. Kenya: Fort Hall, USNM 163948. Wambugu, USNM 163952. Nyeri, USNM 163953–955.

Crocidura hildegardeae lutreola (Heller, 1910). Kenya: Mt Mbololo, summit, USNM 182456, 182459, 182460.

Crocidura hildegardeae phaios (Setzer, 1956). Sudan: Torit, 2300', FMNH 66712.

Crocidura hildegardeae procera (Heller, 1912). Kenya: Mt. Garguez, south creek 3600', USNM 182509, FMNH 47357. Mt. Lololokwi, summit, 6000', USNM 182512, 182513, 182517, 182518; FMNH 47358. Mt. Lololokwi, 182522.

Crocidura niobe (Thomas, 1906). Uganda (5): Ruwenzori Mountains, 6200', FMNH 144181, 144183, 144185, 144190; Mt. Sabinio, FMNH 26477.

Myosorex babaulti (Heim de Balsac and Lamotte, 1956): Burundi, Kibira NP, FMNH 148937 1M, FMNH 148938 1M, FMNH 148265 1M, 2100–2350 m; DR CONGO, Kahuzi-Biega NP, Tshibati, FMNH 189275 1M, ZFMK 68.545, 1F, Lwiro Falls, 2100 m, AMNH 180956–180961, 6M; UGANDA, Bwindi-Impenetrable NP, 1850 m, FMNH 160175 1M, Mgahinga Gorilla NP, 2980 m, FMNH 157410 1M.

Myosorex blarina (Thomas, 1906): DR CONGO, Rwenzori Mountains, FMNH 26285–26287 2M, 1F; UGANDA, Rwenzori Mountains NP, FMNH 144205–144211, 2M, 4F, 1?, 1900–3980 m.

Myosorex bururiensis (Kerbis Peterhans & Hutterer, 2010): Burundi, Mumushwizi Valley, Bururi Forest, 1880m, FMNH 155923 F.

Myosorex geata (Allen and Loveridge, 1927): Tanzania, Uluguru Mountains, Uluguru North Forest Reserve 1345–1535 m, FMNH 158298–158302, FMNH 158487 3M, 3F, Mbete, TRP 2305.

Myosorex gnoskei (Kerbis Peterhans et al., 2008): FMNH 191568, Malawi, Chilinda Rest Camp, Nyika National Park, 2285m.

Myosorex kihaulei (Stanley & Hutterer, 2000): Tanzania, Udzungwa Mountains, New Dabaga/Ulangambi Forest Reserve, 1816–1940 m, FMNH 169509–169516, 1?, 7F; West Kilombero Scarp Forest Reserve, 1140 m, FMNH 169501, 1?.

Hybomys lunaris (Thomas, 1906): Uganda, Ruwenzori Mountains, FMNH 144400, 144405, 144408, 144412, 144429, 144430, 144433, 144444, 4M, 4F.

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On the Linck collection and specimens of snakes figured by Johann Jakob Scheuchzer (1735) – the oldest fluid-preserved herpetological collection in the world?

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Abstract. One of the great private natural history cabinets of the 18th century was that of the Linck family of Leipzig pharmacists. Parts of the collection have survived to the present and form the core of the Naturalienkabinett Waldenburg in Saxony, Germany. The collection was particularly rich in reptiles and was documented by Johann Jakob Scheuchzer in his *Physica Sacra* (1731–1735), which figured 67 specimens of snakes and amphisbaenians based on a set of unpublished illustrations, the *Icones Serpentum et Viperarum*, prepared under the direction of Johann Heinrich Linck the Elder. We review the original herpetological content of the Linck collection as documented by Johann Heinrich Linck the Younger in his *Index Musae Linckiani* (1783–1787) and provide both a summary of earlier identifications (to 1858) of the species depicted in the *Icones* and *Physica Sacra* and new identifications based on our research. Some of these snakes served as holotypes or syntypes of species described by Linnaeus and Blasius Merrem and, thus, are of taxonomic significance. As many as 11 of these illustrated specimens (although none of them types), and an unknown number of others, are still extant in Waldenburg. At a minimum, these specimens were present in the Linck collection in 1729, but they may be as much as half a century older, as the reptile collection was already large and well-known by the debut of the century. Even at the minimum age possible, the surviving Linck snakes figured by Scheuchzer are among the oldest documented fluid-preserved herpetological specimens in the world.

Key words. Johann Heinrich Linck, Naturalienkabinett Waldenburg, *Physica Sacra*, Johann Jakob Scheuchzer, Serpentes, historic collections.

INTRODUCTION

Natural history cabinets, either self-standing, or as part of more inclusive curiosity cabinets or Kunstkammer, were a well-established feature of educated society throughout much of Europe by the late 16th century and flowered in the 17th century as the expansion of global trade and travel provided ever more subjects for collection and study (Seifert 1935; MacGregor 2007). Although many of the most sumptuous cabinets were owned by royal families and other aristocrats, there were also a great many scholarly and private cabinets, many of which were owned by physicians and apothecaries for whom objects of natural history were of professional as well as personal interest.

Perhaps the most famous of the early private natural history cabinets was that of Ulisse Aldrovandi (1522–1605), today represented by a variety of dried specimens and an extensive "paper museum" of contemporary paintings of natural objects (Alessandrini & Ceregato 2007; Bauer et al. 2013). Many others survive only in the form of published catalogues and iconic images, for example the museums of Francesco Calzolari (1521–1600; Ceruti & Chiocco 1622), Ferrante Imperato (1550–1625; Imperato 1599), Basilius Besler (1561–1629; Besler 1616, 1622, 1642), and Ole Worm (1588–1654; Worm 1655, see also Schepelern 1987, 1990). Not until the late 17th century when William Croone [or Croune] (1633–1684) and Robert Boyle (1627–1691) began experiments involving the alcohol preservation of organic specimens (Croune 1662 in Birch 1756; Boyle 1663 in Birch 1756; Boyle 1666) did fluid-preserved specimens become a hallmark of such collections.

Many of the spirit-preserved collections from the first third of the 18th century or earlier featured human anatomical preparations. Some still survive, including specimens from the collections of Bernhard Siegfried Albinus (1697–1770) in Leiden (Habrich 1994) and Frederik Ruysch (1638–1731), who sold his famous collection of anatomical specimens to Peter the Great in 1717 (Luyendijk-Elshout 1994; Driessen-van het Reve 2006). The latter included many skeletal preparations as well as dry injected mounts, none of which appear to have survived, but also fluid preserved material, some of which is still extant in St. Petersburg (Driessen-van het Reve 2006).

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Fig. 1. Stuffed anaconda (*Eunectes murinus*) from the first collection of Albertus Seba on display in the Zoological Institute of the Russian Academy of Sciences, St. Petersburg. The head of the specimen was missing and a new "head" fashioned from the front of the skin. Photo courtesy of Daniel A. Melnikov.

Zoological collections were also popular in natural history cabinets of this period and these often contained large numbers of fluid-preserved amphibians and reptiles (George 1987). Mostly obtained from the tropics, these were generally small, easy to store and display, and attractive to collectors in temperate Europe because of their exotic appearance as well their real and imagined medical significance. Perhaps the most well-known spirit-preserved herpetological collection of the early 18th century was that of Albertus Seba (1665–1736) who sold his first collection to Peter the Great in 1716 (Engel 1937; Driessen-van het Reve 2006) and then built an even larger second collection. All herpetological components of the first collection, except a stuffed anaconda (Fig. 1) and perhaps a few other dry preparations appear to have been lost (Juriev 1981), but remnants of the second collection are known to exist in a variety of museums, having been dispersed through a series of auctions following Seba's death (Boeseman 1970; Juriev 1981; Thireau et al. 1998; Bauer 2002; Daszkiewicz & Bauer 2006; Driessen-van het Reve 2006; Bauer & Günther 2013).

Fig. 2. Suspended stuffed crocodile (*Crocodylus niloticus*) mount and (below, in cabinets) spirit-preserved collection of amphibians, reptiles and other material in the Franckesche Stiftungen in Halle. The painted cabinet fronts are modern but reproduce historical designs. Photo: A. M. Bauer.

Older still is the collection of the Franckesche Stiftungen in Halle, established in 1698 as part of the orphanage and educational complex founded by August Hermann Francke (1663–1727) (Köhler 1799; Sauerlandt 1911; Storz 1962; Jahn 1994; Müller-Bahlke & Göltz 1998, Müller-Bahlke 2004). Today this collection includes 28

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[a]

[b]

Johann Heinrich Linck der Jüngere (1734—1807)
(Stich von G. G. Endner nach einem Gemälde von Knorr)

[c]

[d]

Plate 1. a. Heinrich Linck (1638–1717), founder of the Linck collection and of the Linck apothecary dynasty in Leipzig. Image from Seifert (1934) from an engraving by Nicolaus Haublein. **b.** Johann Heinrich Linck the Elder (1674–1734), son of Heinrich Linck and accomplished naturalist and pharmacist. Image courtesy of U. Budig, Museum Waldenburg – Naturalienkabinett und Stadtmuseum. **c.** Johann Heinrich Linck the Younger (1734–1807), grandson of H. Linck and son of J. H. Linck the Elder, who prepared the *Index Musae Linckiani*. Image from Seifert (1934) from an engraving by G. G. Endner. **d.** Fürst Otto Victor I von Schönburg-Waldenburg (1785–1859), who purchased the remaining portions of the Linck collection in 1839, establishing it in its existing building in 1844. Image courtesy of U. Budig, Museum Waldenburg – Naturalienkabinett und Stadtmuseum.

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Fig. 3. Exterior of the Museum Waldenburg Naturalienkabinett und Heimatmuseum in 2005. Photo: A. M. Bauer.

early 18th century alcohol preparations consisting chiefly of amphibians and reptiles as well as embryonic material (Altner 1984; Fig. 2). However, perhaps the most important intact herpetological collection from the dawn of fluid preservation is that established by the pharmacist Heinrich Linck (1638–1717; Plate 1a) in Leipzig, Germany. Linck was one of many European apothecaries who assembled such collections during the 17th century (Dilg 1994), but his collection, augmented by his son and grandson, is one of few that has survived – in part – the vagaries of more than 300 years of turbulent European history. Today the collection forms part of the Museum Waldenburg (Fig. 3) in the small Saxon town of Waldenburg, 67 km south of Leipzig, Germany and is regarded as one of the very oldest surviving museum collections of this kind (Mohr 1940; Fleck et al. 1990; Zinke 1999).

No records exist documenting the oldest parts of the collection and thus the unambiguous identification of any portions of the collection dating from Heinrich Linck's time is not possible. Nonetheless, the collection includes a number of distinctive specimens of various kinds that date from the first decades following Heinrich Linck's death. For example, the famous "chicken man" (Hühnermensch), a malformed human foetus, was described and figured in 1737 by Gottlieb Friderici and is still extant today (Müller 1999). Other specimens from these early days that are still present in the collection include a number of distinctive fossils (Rößler 1999a, 1999b), among them examples of "lying stones," crude fossil forgeries described by Beringer (1726), raw and worked mineral samples (Thalheim 1999), a collection of wood samples (Beyrich 1990; Otto & Otto 1999), and the dried echinoderms that were figured by Heinrich Linck's son, Johann Heinrich Linck the Elder, in his treatise *De Stellis Marinus* (1733a, 1733b). The collection at Waldenburg also includes a number of Linck birds from the 18th century (Steinheimer 2005).

On September 25–26, 2005 and again on June 22–23, 2009 we visited the Naturalienkabinett Waldenburg in order to examine its herpetological collections and to determine if any of the specimens therein could be confirmed as having survived from the early 18th century portion of the collection. Whether any material dates to the 17th century founding collection by Heinrich Linck is unknown, and probably unknowable, but the accurate illustration of some of the specimens of the Linck collection before 1730 (Scheuchzer 1735) provides a benchmark for establishing a minimum age of any illustrated specimens that still survive. Such specimens could, however, be as much as 60 years older. Thus, it is possible that any such extant specimens might represent the oldest fluid-preserved herpetological specimens in the world.

BUILDING OF THE LINCK COLLECTION

Heinrich Linck was born in 1638 in Danzig, a center of natural history collections and later home to Jakob Theodor Klein and other notable naturalists and collectors (Friedrich 2001; Daszkiewicz & Bauer 2006). He came to Leipzig in 1669 and first managed and then (1671) leased the pharmacy "Zum Goldenen Löwen", becoming its owner in 1686 (Bormann 1909; Seifert 1934, 1935; Beyrich 1994; Budig 1999b; Friedrich 2001). The pharmacy, as the Löwenapotheke, is still in business in its original position on Grimmaische Straße (Fig. 4) and in 2009

Fig. 4. The Löwenapotheke, on Grimmaische Straße, Leipzig has functioned as a pharmacy for over 600 years and was first managed by Heinrich Linck in 1669 under the name "Zum Goldenen Löwen." Photo: A. M. Bauer.

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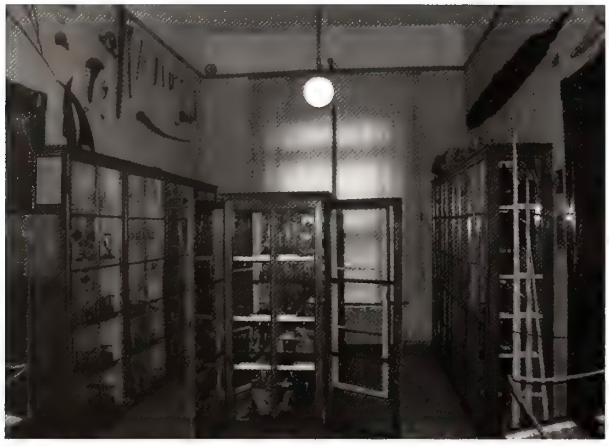

Fig. 5. View of the Green Room, housing the bulk of the herpetological collections, on the first floor of the Museum – Naturalienkabinett Waldenburg. Photo: A. M. Bauer.

celebrated its 600th anniversary. Linck began collecting natural history specimens around 1671 or 1672 (Bormann 1909), although the details of the foundation of his natural history cabinet are largely unknown (Beyrich 1994; Budig 1999b), and continued to enlarge its holdings until his death in 1717. The collection became a family passion and the collection was enlarged by Heinrich's son, Johann Heinrich Linck the Elder (1674–1734; Plate 1b) and later by his grandson, Johann Heinrich Linck the Younger (1734–1807; Plate 1c).

Johann Heinrich the Elder established an extensive trading network with other collectors and also purchased material from all over the world. During his travels across Europe, Linck visited the important collections of Seba in Amsterdam, Klein in Danzig, and Sloane in London, amongst others (Seifert 1934, 1935; Beyrich 1994; Budig 1999b). As well as being a collector, Linck was a scientist himself and published an important work on starfish and related echinoderms (Linck 1733a, 1733b) and conducted a variety of entomological experiments (Seifert 1934; Beyrich 1994). He was also a member of the Kaiserlich Leopoldinisch-Carolinische Akademie der Naturforscher, and a corresponding member of the Accademia delle Scienze dell'Instituto di Bologna and the Royal Society of London (Lingke & Lingke 1909; Beyrich 1994; Budig 2007). After his death the collection languished for a time until his son came of age and took over both the pharmacy and the collection in 1757.

Johann Heinrich Linck the Younger subsequently enriched the collections by the purchase of the large natural history collection of Johann Christoph Richter (1689–1751) in 1784 (Beyrich 1994). Most importantly he reorganized the collection, largely after Linnaeus's *Systema Naturae* and published an extensive catalogue (Linck 1783–1787) listing the material then present, which included approximately 3,400 zoological items (Budig 1999b).

The Linck collection was already well known for its size and diversity by the early 18th century (Kanold in Neickelius 1727) and for many years thereafter it was noted as one of the treasures of Leipzig (Schulz 1784; Leonhardi 1799, Klemm 1838) and was visited by important zoologists, including Marcus Elieser Bloch (1723–1799), Johan Christian Fabricius (1745–1808), and Lorenz Oken (1779–1851) (Mohr 1940). Linck was honored by Johann Gottlob Schneider (1750–1822) who dedicated his *Amphibiorum Physiologiae, Specimen Alterum* (1792, 1797) "ad virum doctissimum Iohann. Henricum Linck Serenissimo Saxoniae Electori a Consiliis Commerciorum Academiae Caesareae Naturae Curiosorum Socium et cet." and, indeed, the last four pages of the work extol Linck's virtues and the value of his collection.

Following the death, in 1807, of Johann Heinrich Linck the Younger, his widow Dorothea Linck leased the pharmacy, eventually selling it to Karl Heinrich August Rhode in 1818. Upon her death in 1827, the collection was also purchased by Rhode. Rhode sold the fabulous library (documented by Linck 1787 and today represented by at least some volumes in the Universitätsbibliothek Leipzig) separately as well as some of the spirit-preserved specimens – including snakes and amphibians, but subsequently sold the remaining collection to Fürst Otto Victor I von Schönburg-Waldenburg (1785–1859; Plate 1d) in 1839 for 3,300 Thaler (Seifert 1934; Mohr 1940; Fleck et al. 1990; Beyrich 1994; Budig 1999b; Zinke 1999).

Otto Victor received the material in Waldenburg the following year (Beyrich 1990) and in 1844 moved it into a newly built museum (Budig 1999a; Fig. 3), where it is still housed today. Also in 1840, Otto Victor purchased several other significant natural history collections: the herbarium, mineralogical and geological collection of Dr. Karl Ferdinand Reichel (1800–1860), a pharmacist from Hohenstein (today Hohenstein-Ernstthal), an entomological collection from Karl Gerhardt, and an important collection of birds and other animals from Karl Ferdinand Oberländer (1805–1866) of Greiz, a baker and confectioner as well as an accomplished ornithologist (Heyder 1935; Mohr 1941; Beyrich 1990). The last significant addition to the collection was derived from the African hunting expedition of Otto Victor II (1882–1914) in 1908–1910, consisting chiefly of large mammals and birds.

On 26 October 1928 the Fürstlich Schönburg-Waldenburg'scher Familienverein "Schloß Waldenburg" was founded and subsequently administered the collection. During the period from early 1933 to 1 July 1934 the natural history collection was closed due to major renovations and reorganization of the collection motivated by Fürst Günther von Schönburg-Waldenburg (Seifert 1935; Fischer 1936). On 25 October 1945 control of the collection passed to the Landesverwaltung Sachsen and in 1951 responsibility was transferred to the town of Waldenburg, which continues as the custodian of the collection. Today

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the Naturalienkabinett is housed in the upper floor of the museum building (Fig. 5), whereas the Stadtmuseum (formerly Heimatmuseum) occupies the ground floor.

Its purchase and move to Waldenburg account for the survival of the Linck collection in World War II, when other collections in Leipzig were damaged or destroyed by allied bombing (3–4 December 1943). However, the amalgamation of several collections by Fürst Otto Victor I, as well as his subsequent additions to the collection through the early 20th century clouded the identity of the original Linck collection. Nonetheless, it has been argued that historical museum material can be reasonably identified on the basis of intrinsic evidence in the absence of preserved labels or other documentation (Faxon 1915) and we employ this approach to identify some of the oldest extant specimens in the Linck collection.

HERPETOLOGICAL SPECIMENS IN THE LINCK COLLECTION

From at least the time of Johann Heinrich Linck the Elder, herpetology was a focal point in the Linck collection. By 1727 the collection included 800 jars of spirit preserved specimens, including many snakes and other herpetological specimens (Kanold in Neickelius 1727). By 1783, when the first and only published catalogue of the collection appeared, amphibians and reptiles constituted approximately 50% of the spirit preserved collection, or almost 450 specimens. This is larger than the herpetological collection of Marcus Elieser Bloch, assembled in the mid- to late 18th century, which formed the nucleus of the Zoological Museum of Berlin in 1810 and originally included about 380 specimens (Bauer & Günther 2006).

The catalogue of the Linck collection, the *Index Musae Linckiani* (Plate 2a) was published in three parts between 1783 and 1787 (incorrectly stated to be different editions by MacGregor 2007; now available online through Die Sächsische Landesbibliothek – Staats- und Universitätsbibliothek Dresden at http://digital.slub-dresden.de/werkansicht/dlf/9369/1/0/cache.off). The first part (Linck 1783) includes the section "Die Amphibien. Amphibia," divided into "Schwimmende Amphibien. Nantes," including lampreys, sharks and rays, sturgeons and a diversity of teleosts, "Kriechende Amphibien. Reptiles," including most amphibians and non-avian reptiles except snakes, and "Schleichende Amphibien. Serpentes," including snakes, as well as amphisbaenians, caecilians, and some limbless lizards. The latter two sections occupy pages 61–79 in the catalogue and are followed by a two-page section "Einzelne Theile von Amphibien" comprising skins, eggs, and other parts of "Amphibien" as broadly construed. An appendix in part 1 (Anhang; pages 275–277) lists specimens that initially were overlooked or obtained while the catalogue was in press and includes on page 276 a single additional specimen of a snake (*Coluber coerulescens*) that appears to have been missed initially. The third and last part of the *Index* (Linck 1787) contains a supplement (Additamenta; pages 245–260) that includes three snakes on page 248, one being the same listed in the appendix mentioned above.

Latin names follow Linnaeus (1766) in nearly all cases (Table 1), and in a few instances, Linck cited a descriptive name from Seba's *Thesaurus* (1734, 1735) or another source. German vernacular names are also provided, along with the country or region of origin of the species (if known), and occasionally more extensive comments. Linck collection specimen numbers are also provided as are plate and figure references for those specimens figured in published works (Plate 2b; Table 2). The *Index* lists 10 species of chelonians, 13 species of frogs, one crocodile, two amphisbaenians, one caecilian, 28 species of lizards, three species of salamanders and 63 species of snakes (numerous specimens listed by Linck as varieties of some of these actually represent separate species). In addition, the *Index* lists three large snake skins, snake vertebrae, rattlesnake rattles, numerous snake, turtle and crocodile eggs, and a "snake stone," supposedly taken from the head of a large snake.

It is unknown what cataloguing system, if any, was used prior to the time of Johann Heinrich Linck the Younger. His system (Linck 1783), however, included several categories. Dry preparations were numbered separately from spirit-preserved ones and a separate numbering applied to specimens kept in numbered drawers. Thus, the chelonians included specimens 1–8 in drawer 25, as well as dry preparations 95–100 plus 100A and 100B, and spirit specimens 326 and 327 (Table 1). In total, the spirit specimens range from 293 to 697, but with the addition of a few intercalated specimens with an alphabetical suffix, the total number of spirit-preserved herpetological specimens comes to 411. Dry preparations included eight turtles plus two large snake skins (all probably displayed on the walls or hung from the ceiling) and smaller specimens stored in some of the 184 drawers devoted to zoological specimens (eight chelonians in drawer 25, one frog and seven lizards in drawer 27, two snakes in drawer 24, a third snake skin and an unspecified number of rattlesnake rattles in drawer 127, crocodile and turtle eggs in drawer 17, and snake vertebrae and "snake stone" in drawer 175). Unfortunately, no trace of these earliest labels remains with the specimens today, nor were any labels apparently present at the time of the reorganization of the collection in 1933/34 (Seifert 1935), and no correspondence between these early numbers and those used subsequently can be established, except in cases where the extant specimens are both unique and known to have been part of the collection in the late 18th century.

Another copy of the Linck *Index* in the Universitätsbibliothek Leipzig bears additions in the hand of J.H. Linck

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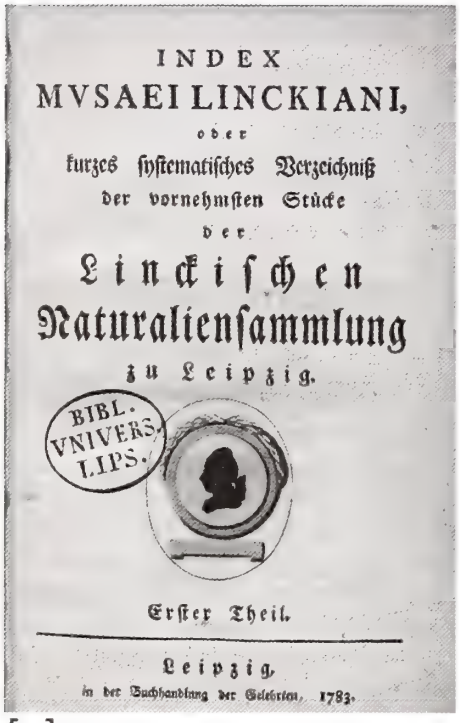
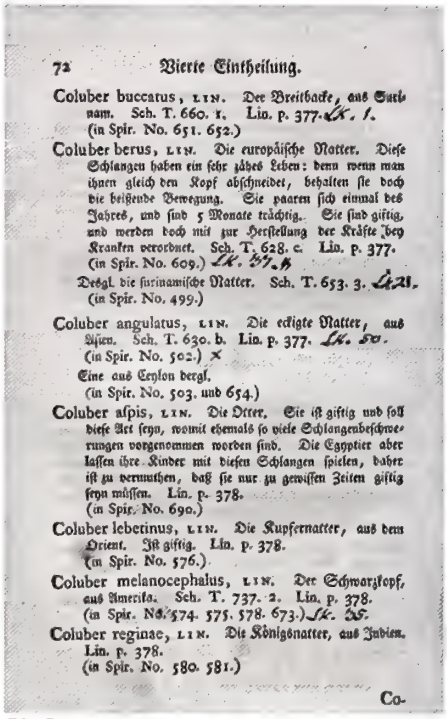
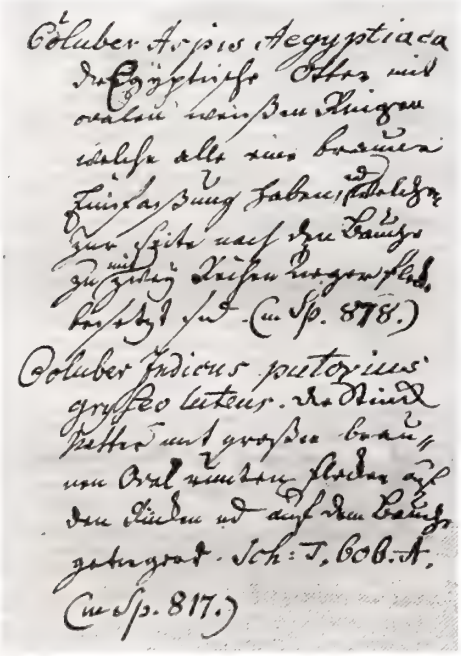

INDEX
MVSAEI LINCKIANI,
oder
kurzes ſyſtematiſches Verzeichniß
der vornehmſten Stücke
der
Linckiſchen
Naturalienſammlung
zu Leipzig.
BIBL. VNIVERS. LIPS.
Erſter Theil.
Leipzig,
in der Buchhandlung der Gelehrten, 1783.

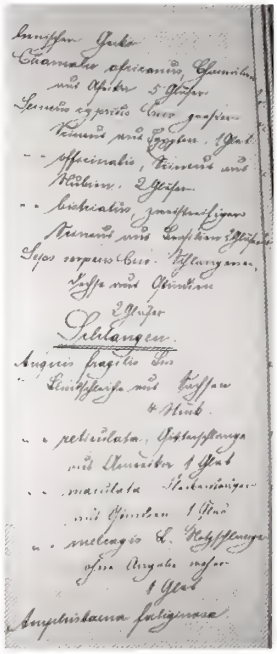
[a]


72 Vierte Eintheilung.
Coluber buccatus, LIN. Der Breitbacke, aus Surinam. Sch. T. 660. 1. Lin. p. 377. LK. 1. (in Spir. No. 651. 652.)
Coluber berus, LIN. Die europäiſche Natter. Dieſe Schlangen haben ein ſehr zähes Leben: denn wenn man ihnen gleich den Kopf abſchneidet, behalten ſie doch die beißende Bewegung. Sie paaren ſich einmal des Jahres, und ſind 5 Monate trächtig. Sie ſind giftig, und werden doch mit zur Herſtellung der Kräfte bey Kranken verordnet. Sch. T. 628. c. Lin. p. 377. (in Spir. No. 609.) LK. 27. b
Desgl. die ſurinamiſche Natter. Sch. T. 653. 3. LK. 21. (in Spir. No. 499.)
Coluber angulatus, LIN. Die eckigte Natter, aus Aſien. Sch. T. 630. b. Lin. p. 377. LK. 50. (in Spir. No. 502.) X
Eine aus Ceylon dergl. (in Spir. No. 503. und 654.)
Coluber aſpis, LIN. Die Otter. Sie iſt giftig und ſoll dieſe Art ſeyn, womit ehemals ſo viele Schlangenbeſchwerungen vorgenommen worden ſind. Die Egyptier aber laſſen ihre Kinder mit dieſen Schlangen ſpielen, daher iſt zu vermuthen, daß ſie nur zu gewiſſen Zeiten giftig ſeyn müſſen. Lin. p. 378. (in Spir. No. 690.)
Coluber lebetinus, LIN. Die Kupfernatter, aus dem Orient. Iſt giftig. Lin. p. 378. (in Spir. No. 576.)
Coluber melanocephalus, LIN. Der Schwarzkopf, aus Amerika. Sch. T. 737. 2. Lin. p. 378. (in Spir. No. 574. 575. 578. 673.) Sk. 25.
Coluber reginae, LIN. Die Königsnatter, aus Indien. Lin. p. 378. (in Spir. No. 580. 581.)
Co-

[b]


Coluber Aspis Aegyptiaca
Die Egyptiſche Otter wird
oben an den Königen
Schlange alle eine besondere
Einsaugung Fabuliſtischer
Sage gehabt auch die Kinder
zu spielen gegeben
(in Sp. 878.)
Coluber Indicus portorius
groſſeo luteus. Die Rind
Natter und große braun
und Roth gefleckten auf
dem Rücken und auf dem Bauch
getigert. Sch: T. 60. A.
(in Sp. 817.)

[c]


Anguis fragilis
Coluber natrix
Coluber flavescens
Coluber aesculapii
Coluber lacertinus
Coluber quadrilineatus
Coluber viridiflavus
Coluber melanogaster
Coluber leopardinus
Coluber angulatus
Coluber reginae
Amphisbaena fuliginosa

[d]

Plate 2. **a.** Title page of volume I of the *Index Musae Linckiani* (1783). Image courtesy of Universitätsbibliothek Leipzig. **b.** Typical snake specimen accounts in the *Index Musae Linckiani* (1783) showing Linck's associations with names from Linnaeus (1766) and reference to Scheuchzer (1735) plates. "LK" (Linck Kabinett) numbers corresponding to the illustration numbers in the *Icones Serpentum et Viperarum* have been added in the hand of J. H. Linck the Younger. Image courtesy of Universitätsbibliothek Leipzig. **c.** Reverse of inserted leaf in the Universitätsbibliothek Leipzig copy of the *Index Musae Linckiani* (1783), with additions in the hand of J. H. Linck the younger. Image courtesy of Universitätsbibliothek Leipzig. **d.** Page of reptile entries in *Verzeichnis der im Fürstlichen Museum zu Waldenburg befindlichen Gegenstände* (Archiv Museum Waldenburg, 315), the 1886 hand-written version of the museum catalogue. Photo: A. M. Bauer.

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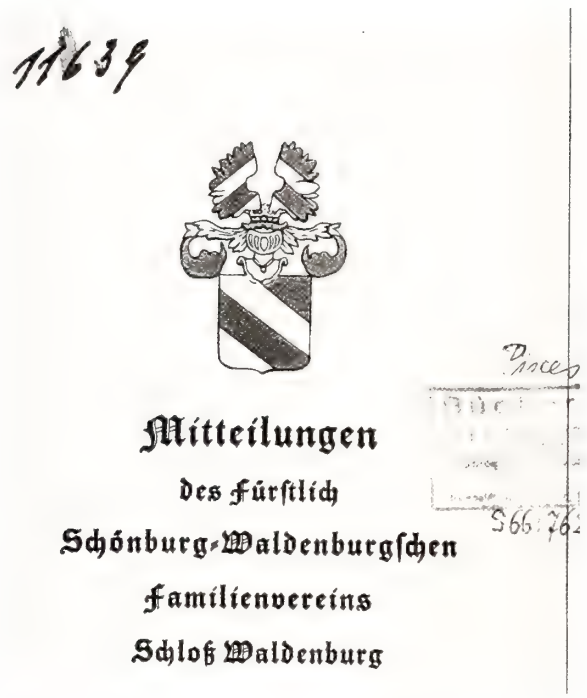

Fig. 6. Cover of number 8 (Mohr, 1940) of *Mitteilungen des Fürstlich Schönburg-Waldenburgschen Familienvereins*, published by the Familienverein "Schloß Waldenburg." Courtesy of Museum für Naturkunde, Berlin.

himself (Mohr 1940; Budig 1999b). In the herpetological portion of the catalogue there are three such annotations. On page 76, specimen number 684 has been stricken out under the entry for *Coluber haie* and, on a leaf inserted after this page, the same number has been assigned to *Coluber Dipsas* (specimen 684). On the reverse of the same leaf *Coluber Aspis Aegyptiaca* (specimen 818) and *Coluber Indicus putorius gryseo-luteus* (specimen 817) have both been added (Plate 2c). These changes must have been made very shortly after the publication of the catalogue, as the third part of the catalogue (Linck 1787) includes an Additamenta section in which they are printed along with reference to the originally omitted specimen of *Coluber coerulescens*. Further, the specimen numbers assigned to the two new entries closely follow the highest number for a spirit preserved specimen in the first part of the catalogue (815, a monkey mentioned in the list of specimens obtained while the catalogue was in press). This also suggests that specimens added after the publication of the catalogue were given sequential numbers, regardless of the taxonomic group to which they belonged.

Following Linck's catalogues (1783–1787) the next recorded accounting of the herpetological holdings of the collection was the *Verzeichnis der im Fürstlichen Museum zu Waldenburg befindlichen Gegenstände* (Archiv Museum Waldenburg, 315). This handwritten document, prepared in 1886, lists the spirit preserved amphibians and reptiles on 10 pages. In this list, which uses contemporary nomenclature, no specimen numbers are listed, only the number of jars (Plate 2d). This list certainly includes newer material, probably from the Oberländer collection – also purchased by Otto Victor in 1840, as distinctive species, such as *Phrynosoma orbiculata* [sic], not from the Linck collection, are included. However, a diversity of material corresponding to the older collection is also listed. Three handwritten copies of this document exist at the Museum, differing only in presentation but not content with respect to "Amphibien in Spiritus."

In the 1930s a major reorganization of the Naturalienkabinett was undertaken in which an attempt to identify the Linck specimens present since at least the time of Johann Heinrich the Younger was made. This took place during the time of Prince Günther of Schönburg (1887–1960) who took an active interest in the museum and its collections and was active in the Fürstlich Schönburg-Waldenburg'scher Familienverein "Schloss Waldenburg," which published its own *Mitteilungen* (Fig. 6), with contributions about the historical collections.

The identification of these early specimens was carried out in 1933 and 1934 by the mineralogist Alfred Seifert (1906–1953) and the zoologist Konstantin Leopold Wöpke (????–1944; Fig. 7) as part of a major reorganization

Fig. 7. Zoologist Konstantin Wöpke (left), museum guard Albin Clauder (center), and mineralogist Alfred Seifert (right) in front of the Museum Waldenburg Naturalienkabinett und Heimatmuseum in 1933 or 1934. Wöpke and Seifert reorganized the Waldenburg Museum collections and attempted to identify material dating to the time of Johann Heinrich Linck the Younger. Image courtesy of U. Budig, Museum Waldenburg – Naturalienkabinett und Stadtmuseum.

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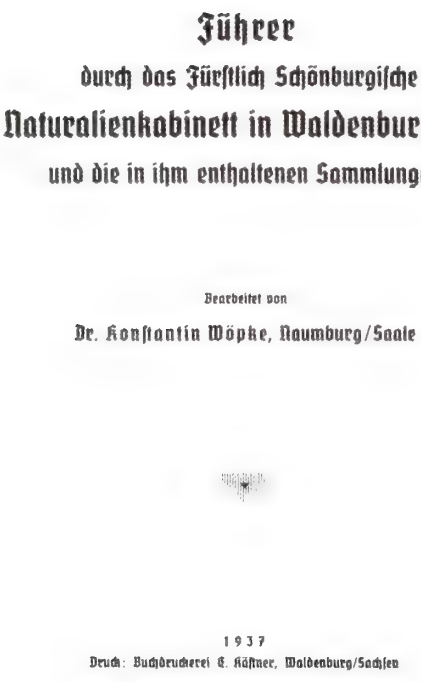

Führer

durch das Fürstlich Schönburgische

Naturalienkabinett in Waldenburg/Sa.

und die in ihm enthaltenen Sammlungen

Bearbeitet von

Dr. Konstantin Wöpke, Naumburg/Saale

1937

Druck: Buchdruckerei E. Kästner, Waldenburg/Sachsen

Fig. 8. Title page of the guide to the reorganized Waldenburg Museum prepared by K. Wöpke (1937).

of the Waldenburg collections (Budig 1999a), although subsequent workers have identified other zoological specimens from Linck's collection that were not recognized as such during the 1930s (Mohr 1940). Exactly how presumed original Linck specimens were recognized is unknown. It is unclear if the jars used at the time of the cataloguing in 1783 were actually numbered, or if the positions of the jars on shelves were numbered. In either case, no unambiguous numbering system of specimens seems to have survived to the 20th century (Seifert 1935), nor does the earlier catalogue of 1886 suggest that any numbering system was present at that time (Wöpke 1937). Rather, it is likely that Wöpke tried to match specimens to those listed in Linck (1783–1787). Seifert (1934, fig. p. 36; 1935, fig. 1) figured a selection of spirit-preserved specimens, chiefly snakes, that were supposedly from the Linck collection. No markings can be seen on the jars (although some numbering system may have been used on the top of the bladders capping the jars). Wöpke, who had actually published a single paper in herpetology (Wöpke 1930) based on his Inaugural-Dissertation from the University of Leipzig, later published a visitor's guide to the collections (Wöpke 1937; Fig. 8) in which he stated that he believed that a large number of the specimens on display dated to the time of J.H. Linck the Younger.

Specimens believed to be part of the original (pre-1783) Linck collection were given red labels in the 1933/34 reorganization (Beyrich 1990; Fleck et al. 1990) and these remain associated with these specimens today. Material present at the time of the reorganization is recorded in the *Accessions Katalog der zoologischen Abteilung des Fürstlich-Schönburgischen Museums zu Waldenburg i./Sa.* (Archiv Museum Waldenburg 342; Fig. 9) prepared by Wöpke. In this document, ruled columns record Lfde. Nr. (consecutive number = a different number assigned to each species), Bezeichnung (description = species and type of preparation), Fundort bezw. Vorkommen (locality or, more commonly, distribution), Zahl (number of specimens), Dat. (date – only for "modern" specimens), Standort (physical position in the collection), and Bemerkungen (remarks – generally correspondence to the page and specimen number in the *Index Musae Linckiani*). In general, the first three columns are typed and others have entries in ink; additions and corrections to the names and localities are also entered in ink in Wöpke's hand. The old collection of amphibians and reptiles occupies seven pages in the catalogue. In addition, two mounted reptiles are listed from the African trip of Otto Viktor II, both collected in 1908: "2069, *Crocodilus* [sic, *Crocodylus*] *niloticus* Laur., Nilkrokodil, Afrika" and "2070, *Emys orbicularis*

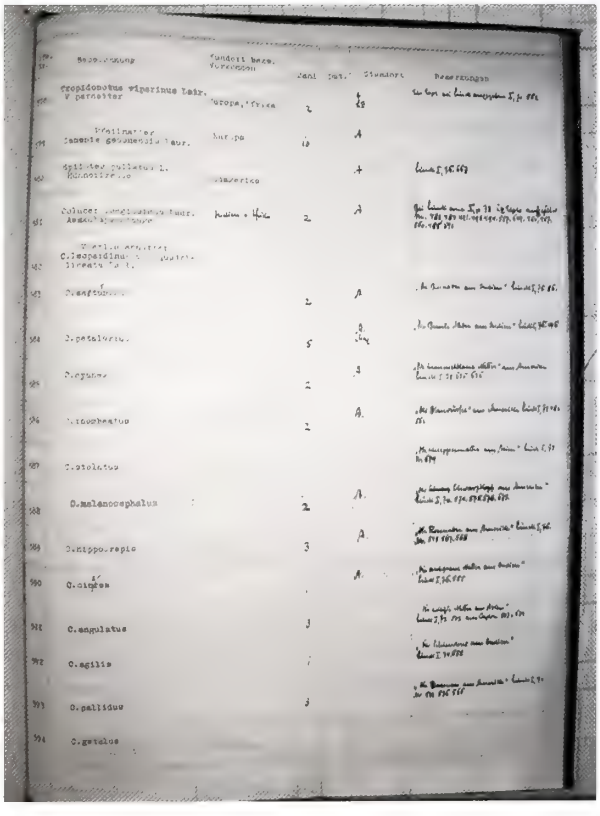

Fig. 9. Page of reptile specimens from *Accessions Katalog der zoologischen Abteilung des Fürstlich-Schönburgischen Museums zu Waldenburg i./Sa.* (Archiv Museum Waldenburg 342), a catalogue of the collection prepared by K. Wöpke during the reorganization of the museum in 1933. Photo: A. M. Bauer.

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Fig. 10. View of part of the herpetological collection in the Naturalienkabinett Waldenburg showing jars sealed with glass plates and covered in picein that were prepared during the 1994 reorganization of the collection. Photo: A. M. Bauer.

L., Sumpfschildkröte, Europa u. Westasien" [this specimen is actually the large and highly distinctive softshell turtle, *Trionyx triunguis*, the misidentification suggests that Wöpke's knowledge of systematic herpetology was limited]. The number of entries for the old collection totals 98 species and approximately 250 specimens, falling in the number range 527– 645. The next inventory was conducted in 1994 and was recorded on index cards, one per specimen, each with data on one side and a black and white photo on the reverse. The specimens were each given numbers (applied to their jars or to the specimens themselves in the case of dry preparations), where the number is not shared with either the *Index Musae Linckiani* or the 1933/34 *Accessions Katalog*. Each number is prefaced by a Roman numeral "I," signifying a zoological object, and followed by the designation "A_3," indicating a herpetological specimen according to the museum inventory system devised by Knorr (1957). These same specimen numbers were recorded in the most recent inventory (2001) and small labels bearing these numbers have been uniformly affixed to specimen jars and dry specimens or their mounts.

The existing fluid preserved specimens were last topped-up with ethanol and their containers sealed in 1993–1994 by the then preparator of the Museum, Olaf Zinke. At least some of the containers of amphibians and reptiles are conserved in 80% alcohol (presumably ethanol) and 5% glycerin, as recommended by Arndt (1937, 1943). The glass jars are sealed with a glass plate and covered in picein (Fig. 10). Prior to this the preparations were in 95% alcohol and sealed with a tin plate and cow's bladder (Zinke 1999; see Beyrich 1990, fig. 6; Zinke 1990, fig. p. 90), a common sealing technique of the late 18th century (Bauer & Günther 2006). This and other 17th and 18th century methods for sealing glass containers for fluid-preserved specimens were presented by Ruysch (1710), Turgot & Duhamel du Monceau (1758), Pallas (1781), Pole (1790) and Osiander (1793) and these and other methods were later summarized by Naumann (1815), Thomas (1892), Altner (1984), and Carter & Walker (1999).

The existing spirit-preserved collections in Waldenburg comprise 120 fish, 18 amphibians, 95 reptiles and 22 anatomical preparations (Zinke 1999). The fish have been

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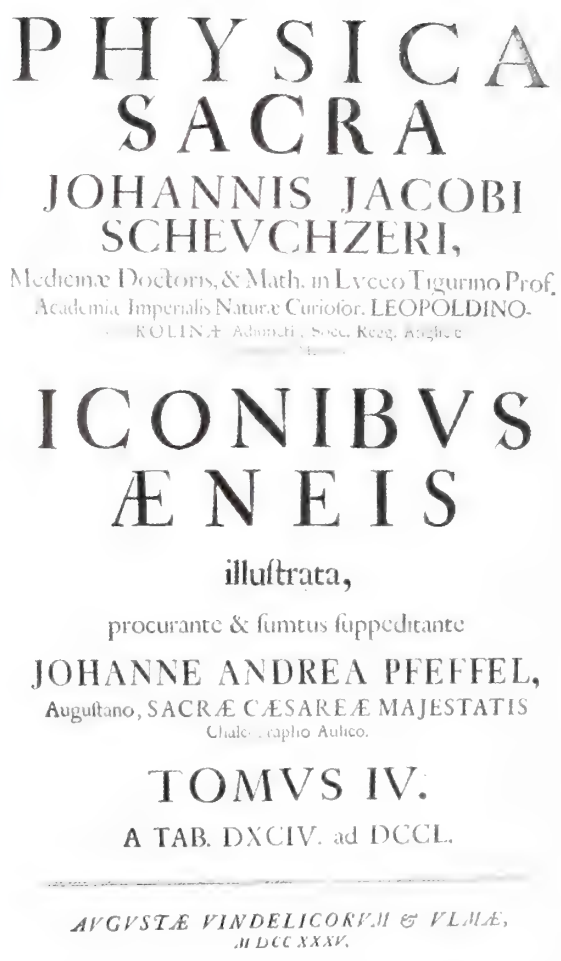
Fig. 11. Dry preparation of a loggerhead sea turtle (*Caretta caretta*) suspended from the ceiling of the "Linckzimmer," a room in the Naturalienkabinett containing specimens believed to be from the period of the Linck family and arranged in the fashion of the 18th century. Photo: A. M. Bauer.

discussed earlier (Mohr 1940). Herpetological specimens, both ethanol preserved and dry preparations, are found chiefly in "das erste grüne Zimmer," whereas a few jars occupy a glass-fronted cabinet on the stairwell landing, and several large sea turtles and some additional spirit preserved specimens are in the "Linckzimmer" in an arrangement that has remained essentially the same since the 1933–34 renovations (Fischer 1936; Fig. 11). Two additional mounted reptile specimens, a Nile crocodile (*Crocodylus niloticus*) and African softshell turtle (*Trionyx triunguis*) dating from Otto Victor II's African expedition are on display in "das braune Zimmer."

SCHEUCHZER, SEBA, AND LINCK'S *ICONES*

From 1714 onward, Johann Heinrich Linck the Elder maintained a correspondence with the Swiss naturalist and physician Johann Jakob Scheuchzer (1672–1733) (Beyrich 1994; Budig 1999b). Linck had just purchased the collection of Christian Sigismund Wolf (1685–1737), which included material in turn obtained from Scheuchzer. In the intervening years, the two exchanged specimens, as well as letters (Beyrich 1994). Linck's letters to Scheuchzer are today preserved as Ms. H 304 (pp. 211–306) in the Zentralbibliothek Zürich. Linck had originally planned to publish one or more works on zoology, including snakes, with Albertus Seba, and had even sent copper engravings of snakes and other specimens to him. However, Seba returned these to Linck, although he had made copies, some of which served as the basis for illustrations in Seba's own *Thesaurus* (1734–1735). As has often been noted, however, Linck objected to plate layouts like those of Seba, which combined a variety of unrelated natural history objects in order to achieve an artistic effect (Müsch 2000). Ultimately he turned to Scheuchzer in order to have his snake images published.



PHYSICA
SACRA
JOHANNIS JACOBI
SCHEVCHZERI,
Medicinæ Doctoris, & Math. in Lyceo Tigurino Prof.
Academiæ Imperialis Naturæ Curiosor. LEOPOLDINO-
[illegible] Adamici, Soc. Reeg. Anglicæ

ICONIBVS
ÆNEIS
illustrata,
procurante & sumtus suppeditante
JOHANNE ANDREA PFEFFEL,
Augustano, SACRÆ CÆSAREÆ MAJESTATIS
Chalcographo Aulico.

TOMVS IV.
A TAB. DXCIV. ad DCCL.

AVGVSTÆ VINDELICORVM & VLMÆ,
MDCCXXXV.

Fig. 12. Title page to volume 4 of the *Physica Sacra* (Scheuchzer 1735), which includes all 24 of the plates depicting Linck's snake collection.

Scheuchzer's *Physica Sacra* or "Copper Bible" (1731–1735; Fig. 12) was illustrated by 760 copper engraved plates, the vast majority of which depicted biblical scenes incorporating aspects of natural history, which were designed by Johann Melchior Füßli (1677–1736) and engraved by Johann Andreas Pfeffel (1674–1748) (Fischer 1973; Müsch 2000). The history of this grand undertaking and its execution are chronicled by Müsch (2000). Included among the biblical scenes were a number of plates illustrating actual natural history specimens. Among these was the famous *Homo diluvii testis* (first described by Scheuchzer in 1726) as well as 24 plates (606, 628–630, 647–648, 652–655, 657, 660–662, 678, 715, 717, 737–739, 746–749) depicting 67 snakes and amphisbaenians from the Linck collection (Table 2), all in the fourth and final volume of the work. These plates appear to have been executed by 1730 (Seifert 1934), establish-

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ing a minimum age of specimens illustrated in the *Physica Sacra*.

The Leipzig University Library today holds a set of colored illustrations of fish and reptiles (*Icones Piscium Musei Linckiani nach daselbst befindlichen Originalen gemahlt* and *Icones serpentum et viperarum Musei Linckiani nach daselbst befindlichen Originalen gemahlt* – hereafter simply the *Icones*), rediscovered in 1998, that are believed to have been the original drawings upon which the plates of Scheuchzer were ultimately based (Budig 1999b, Zinke 1999). The snakes are illustrated with one specimen per sheet, except for plate LXVII, on which two snakes are figured. The paintings were originally prepared under the direction of Johann Heinrich Linck the Elder and were sent to Scheuchzer no later than 1730 (they are mentioned in a letter sent by Linck to Scheuchzer on 17 March 1730; Zentralbibliothek Zürich Ms. H 304). In the text accompanying the first of the Linck snake plates (pl. 606) Scheuchzer (1735) specifically mentions that J.H. Linck had sent him color illustrations for use in preparing the plates. Johann Heinrich Linck the Younger subsequently bound the paintings returned by Scheuchzer and appended his own notes to them (Budig 1999b). Linck's notes, in Latin, appear on the pages facing the corresponding plates. They typically provide the Roman numeral of the plate, a copy of the text from Linnaeus (1766) for the species to which Linck believed each snake to belong, and, at the bottom, Scheuchzer's (1735) plate and figure designation, a page reference to Linnaeus (1766), and the collection number of the spirit specimen illustrated, as recorded in the *Index Musae Linckiani*. Presumably, when multiple specimens were listed these also included specimens referable to not only to the same species as recognized by Linck, but also the same variety or form (see Table 1). In all there are 89 plates numbered I–XC (plate LXXXVI is apparently lacking, see Table 3). The first 67 of these, with the exception of number LXVI, are all represented by figures and accompanying text in Scheuchzer (1735) and of these only IV and XLVII are not explicitly associated with particular spirit specimens (although the number of the specimen corresponding to plate XLVII was handwritten into Linck's annotated copy of the *Index*). Plates 68–90 generally lack text and references to Linck collection specimens, although plates LXXII, LXXIX, LXXXIV, and LXXXV do correspond to particular specimens (Table 3).

The Roman numeral plate numbers in the *Icones* are equivalent to "Musei Linckiani" specimen numbers represented in Arabic numerals on the *Physica Sacra* plates for each corresponding species and corroborate that the *Icones* illustrations were available to Scheuchzer. These same numbers were also added to the annotated copy of the *Index* in in Linck's hand, prefaced by "LK" for Linck Kabinett (Plate 2b).

Thirteen pen and wash paintings similar to those in the *Icones*, were offered at an auction in London on 13 May 2004, but went unsold and were offered again for sale in 2013. These each depict multiple specimens, presumably clustered for Scheuchzer's use. Eight of these correspond in content to the finished plates as published in the *Physica Sacra* whereas the remaining five images were never published and possibly never even engraved. These paintings appear to be annotated in Linck's hand, suggesting that they were prepared in Leipzig rather than having been executed in Zürich from drawings sent by Linck. The correspondence between these paintings and those in the *Icones* is exact and the former were probably traced from the latter.

TAXONOMIC SIGNIFICANCE OF THE LINCK COLLECTION

During the 18th century, the Linck collection was visited by a number of well-known taxonomists, who selected specimens as type material. For example, among ichthyological specimens, the extant holotype of *Lutianus linckii* (or *Lutjanus linkii*; the name is spelled differently in the text and on the accompanying plate in the description *fide* Eschmeyer 1998), a synonym of *Symphodus tinca* (Linnaeus, 1758), was described and figured by Marcus Elesier Bloch (1790), who visited the collection in 1767 (Mohr 1940; Zinke 1999). Although few herpetological taxonomists appear to have seen or worked with the Linck collection, Scheuchzer's plates in the *Physica Sacra* made at least some of the collection well-known to a broad audience. As was common at the time, and well into the 19th century, these images were sometimes chosen as iconotypes and the specimens upon which the images were based served as holotypes or syntypes of validly described taxa. Among the Linck snakes at least seven specimens illustrated by Scheuchzer (1735) represent type specimens. Linnaeus (1758) based two names, in part, on specimens from the Linck collection (Bauer 2012). *Boa scytale*, considered a synonym of *Eunectes murinus* (Linnaeus, 1758) by McDiarmid et al. (1999), is based on indications to a specimen noted by Gronovius (1756:55) and one illustrated by Scheuchzer (1735) as figure 1 on plate 737 of *Physica Sacra* (Plate 3a). Linck (1783), however, considered this illustration to be of *Coluber aesculapii* – nos. 483–484 in the Linck catalogue, a species now called *Scaphiodontophis venustissimus* (Wied, 1821). Linnaeus (1766) later revised and expanded the description of *B. scytale* in the 12th edition of *Systema Naturae* so significantly from that of 1758 as to be unrecognizable as the same species. Smith & Gloyd (1963) consequently restricted the application of the name *Boa scytale* to the anaconda, *E. murinus*, the species clearly intended by Linnaeus (1766) and consistent with the general use of the name over the proceeding two centuries.

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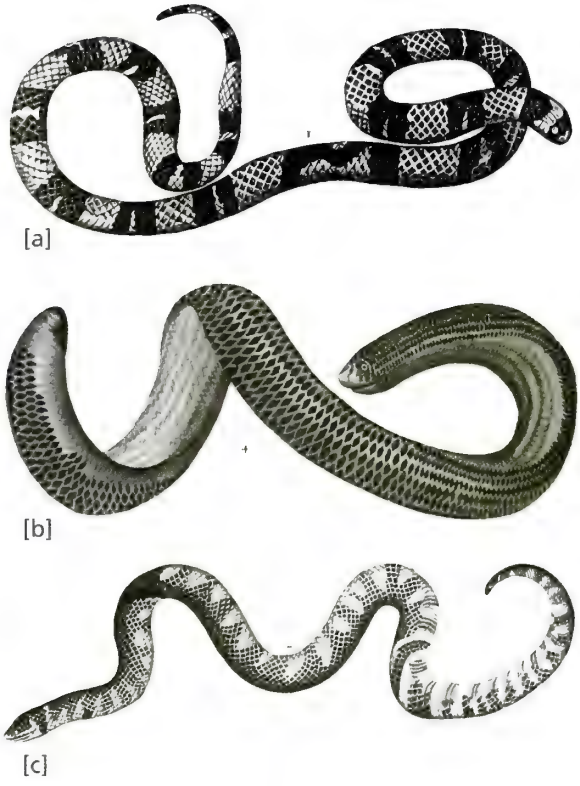

Plate 3. **a.** Figure 1, plate 737 from *Physica Sacra* (Scheuchzer 1735). The Linck specimen illustrated is one of two syntypes of *Boa scytale* Linnaeus 1758 [= *Eunectes murinus* (Linnaeus 1758)] but is actually referable to *Erythrolamprus aesculapii*. (see text for explanation). In this and other figures from *Physica Sacra* elements other than the specimens of interest have been digitally removed for clarity. **b.** Figure 4, plate 747 from *Physica Sacra* (Scheuchzer 1735). The Linck specimen illustrated is one of two syntypes of *Anguis reticulata* Linnaeus 1758 [= *Typhlops reticulatus*]. **c.** Figure 1, plate 647 from *Physica Sacra* (Scheuchzer 1735). The Linck specimen illustrated is the holotype of *Scytale Scheuchzeri* Merrem, 1820 [= *Cylindrophis ruffus* (Laurenti 1768)].

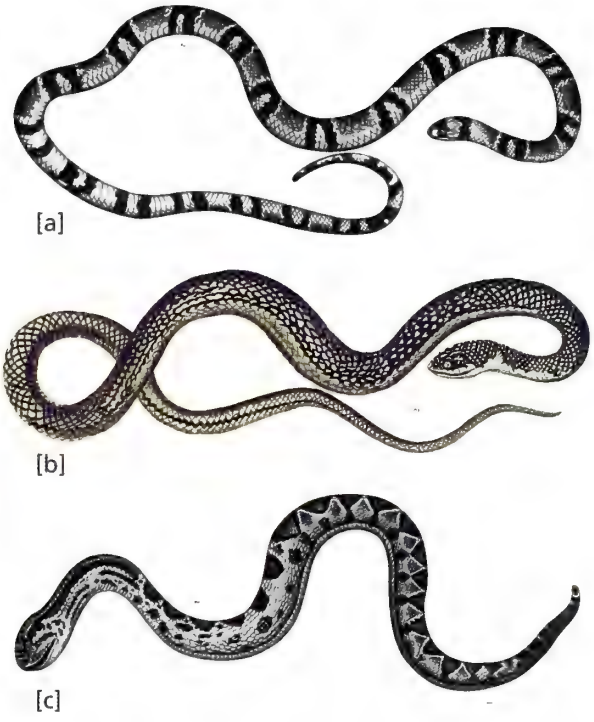

Plate 4. **a.** Figure 2, plate 648 from *Physica Sacra* (Scheuchzer 1735). The Linck specimen illustrated was one of the sources for the description of *Elaps corallinus* Merrem, 1820 [= *Micrurus corallinus*]. **b.** Figure 2, plate 746 from *Physica Sacra* (Scheuchzer 1735). The Linck specimen illustrated depicts the holotype of *Coluber* (*Natrix*) *cancellatus* Merrem, 1820 [= *Liophis reginae* (Linnaeus 1758)]. **c.** Figure 1, plate 648 from *Physica Sacra* (Scheuchzer 1735). The Linck specimen illustrated is a syntype of *Cophias Jararaca* Merrem 1820 [= *Bothropoides jararaca*].

A second Linck specimen serves as a type of the Linnaean name *Anguis reticulata* = *Typhlops reticulatus fide* McDiarmid et al. (1999). Linnaeus (1758) cited both a Gronovius (1756) specimen, and Scheuchzer's illustration (pl. 747, fig. 4). Scheuchzer's illustration clearly shows the diagnostic pale snout and pale tail ring of this species (Plate 3b).

Merrem (1820) also cited a number of Scheuchzer plates in his original descriptions. *Scytale Scheuchzeri* Merrem, 1820, a synonym of *Cylindrophis ruffus*, is based solely on the snake depicted in Scheuchzer's plate 647, figure 1 (Plate 3c). *Elaps corallinus* Merrem, 1820 (now *Micrurus corallinus*) was based on Scheuchzer's plate 648, figure 2 (Plate 4a) and questionably plate 737, figure 1, although the names *Coluber fulvius* Linnaeus, *C. nigro-rufus* La Cépède, and *C. fulvus* Latreille were also associated with the latter specimen by Merrem. According to Roze (1966) Merrem's description was also based on specimens collected by Wied and published on by him later in the same year (Wied 1820). Roze (1966), therefore, designated AMNH 3911, collected by Wied, as the lectotype. Scheuchzer's plate 746, figure 2 (Plate 4b) depicts the holotype of *Coluber* (*Natrix*) *cancellatus* Merrem, 1820, a synonym of *Liophis reginae*. *Cophias Jararaca* (= *Bothropoides jararaca*) also appears to have been described by Merrem (1820) based, in part, on Schecuchzer's plate 648, figure 1 (Plate 4c). However, McDiarmid et al. (1999) and other sources credit the name to Wied (1824). Although *Coluber ornatus* (= *Chrysopelea ornata*) is correctly credited to Shaw, 1802, Schlegel (1837) cited Scheuchzer's plate 606, figure C as an image of a syntype of *Coluber* (*Natrix*) *ornatus* Merrem, 1820. Schlegel (1837) also cited Scheuchzer's plate 630, figure A as the image of the type of *Coluber* (*Natrix*) *Scheuchzeri* (= ? *Platyceps rhodorachis fide* Wallach 2012), although Mer-

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[a]

[b]

TABB. DCLIII. DCLIV. DCLV.

Mich. Cap. VII. verſ 17.

Pulverem in morem Serpentis lingent, ut quæ repunt in terra, & ex habitaculis ſuis contremiſcent, ante DOMINUM DEUM noſtrum paucbunt, & te timebunt.

Lingent pulverem ſicut ſerpens: velut reptilia terræ proturbabuntur de ædibus ſuis: DOMINUM DEUM noſtrum deſiderabunt, & timebunt te.

Vid. Gen. Cap. III. verſ. 14.

Neque hanc prætermitto occaſionem ſiſtendi Serpentes nonnullos ex ἱεροφαντίᾳ *Linckiana*.

Fig. 1. Serpens Americanus cœruleus.

Fig. 2. Serpens Americanus ferrugineo dorſo, maculis per totam laterum longitudinem ſemilunatis nigricantibus; medio albis, ventre albido nigris punctis notato, capite ex ferrugineo & albo vario.

Serpens Americanus ferrugineis variis maculis nigris in dorſo, a latere iquamis ex umbra circulis albis ſemilunatis.

Hæmorrhous, Hæmorrhois, colore eſt arenoſo, per corpus verò notis nigris & albis variegata. *Actius, Auic. Arab.* T. II. p. 138. *Lat.* IV. 6. 3. 36.

Fig. 3. Serpens Surinamenſis aquaticus ex nigro, cœruleo & albo varius, maculis præterea in dorſo nigris, ſed variæ figuræ & magnitudinis.

Serpens vulgaris aquaticus Surinamenſis ex nigro & albo varius.

Alburis varii ſerpentis ſpecies. Giauhari.

Fig. 4. Tab. DCLIV. Serpens Americanus taeniatus, taeniis lationibus cupreis & anguſtioribus fordide albis.

Serpens Americanus annulis majoribus ex cupro & minoribus fordide albo.

Serpens minor Americanus variegatus, taeniis lationibus & annulis nigris.

Fig. 5. Dipſas Surinamenſis capite ex nigro, fuſco & albo vario, diademate ex punctis albis conſtante ornatis, collo ſuperne purpureo-fuſco, ad latera albo, ſemitaeniis dehinc per totam dorſi longitudinem alternis lationibus fuſco-purpureis, anguſtioribus dilutioris purpurae in maculas candidas terminatis, quae ſolae caudam praetentem longam nigricantem decorant: venter flaueſcit.

Dipſas Surinamenſis perbellè notatus.

Ἀπὸ ἀποδεσμεύτου μιλιακοῦ ἀρχόμενο ἀφ'.

Semper ſubobſcura nigricat extrema cauda.

Nicand. de Dipſade v. 337.

Dipſadi ſunt nigredinis veſtigia plurima, & color poſtremae partis vertus caudam ad nigredinem declinat. *Aucenna.*

Serpens albus in capite lineas habens coronae inſtar. *Damir.*

Serpens Americanus longus, craſſus, capite latiori, cauda tenui & longa. *Vinc. Cent.* III. 82.

Serpens Americanus longus, tenuis, capite craſſo, cauda tenui. *Vinc. Cent.* IV. 13.

Serpens Staumenſis longiſſimus variegatus, capite plano & viperino, fuſco-marmoreus. *Vinc. Cent.* IV. 16.

Fig. 6. Tab. DCLV. Serpens Americanus ex luteo & griſeo (vel fuſco) in capite & collo veluti reticulatus, reliquo corpore taeniatus, taeniis veluti fractis.

Ser-

[c]

[d]

Plate 5. **a.** Figure 8, plate 655 from *Physica Sacra* (Scheuchzer 1735). The Linck specimen illustrated is one of the syntypes of *Pseudoboa fasciatus* Schneider 1801 [= *Bungarus fasciatus*]. **b.** Figure 2, plate 657 from *Physica Sacra* (Scheuchzer 1735). The Linck specimen depicted is a syntype of *Dipsas multomaculata* Reinwardt in Boie 1827 [= *Boiga multomaculata*]. **c.** Bottom portion of p. 1296 from *Physica Sacra* (Scheuchzer 1735) showing Latin text related to plates DCLIII–DCLV, which illustrate Linck snakes. **d.** Specimen of *Lacerta marmoratus* = *Polychrus marmoratus* (I2003A$_3$) in the Naturalienkabinett Waldenburg on a red-labeled stand, signifiying its recognition as a Linck specimen by Wöpke in the 1933/34 reorganization of the collection.

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rem (1820) himself listed this image in his account of *Coluber fulgidus*. *Coluber* (*Natrix*) *Linkii*, another Merrem (1820) name, despite its patronymic epithet, was not associated with a Scheuchzer plate by its author.

Schneider's (1801) description of *Pseudoboa fasciatus* = *Bungarus fasciatus* is based in part on material in the Bloch collection (now part of the Museum für Naturkunde, Berlin) and in part on the Linck specimen illustrated on plate 655, figure 8 by Scheuchzer (1735; Plate 5a). Finally, *Dipsas multomaculata* Reinwardt in Boie, 1827 (= *Boiga multomaculata*) was described in part on the basis of the snake figured in Scheuchzer's plate 657, figure 2 (Plate 5b).

THE IDENTITY OF SNAKES FIGURED BY SCHEUCHZER

The identity of the snakes illustrated in Linck's *Icones* and Scheuchzer's *Physica Sacra* has never been adequately resolved. The identifications published by Linck (1783–1787) can only be considered tentative as they were Linck's best guesses based on those species known to Linnaeus at the time of the 12th edition of *Systema Naturae* (1766), which Linck used as his main source. Linnaeus's descriptions were often brief and Linck had no special training or knowledge of snakes, so the margin for error was great. Linck may also have been swayed in his identifications by the presumed geographic origin of the snakes. However, the stated origins of most specimens that reached natural history cabinets in the early to mid-18th century were mostly unreliable, as the material generally came through a series of intermediaries, often via Dutch commercial vessels that may have visited any of the main areas from which reptiles were exported, namely Suriname, the Cape, Ceylon, and the East Indies. In short, Linck's (1783–1787) identifications in the *Index* cannot be relied upon.

Information from Scheuchzer's (1735) text is likewise of little use in identifying the snakes of the Linck collection. It is possible that Johann Heinrich Linck the Elder had sent Scheuchzer some information about the specimens, such as their presumed places of origin, but Scheuchzer seems to have used a combination of classical sources as well as contemporary biological literature, including Hernandez (1651), Marcgrave (1648) and Piso (1658), Kaempfer (1712), Ray (1693), and Kolb (1719), amongst others, in order to provide text that was usually not particularly relevant to the particular snake figured (Plate 5c).

Thankfully, many of the plates in the *Icones* and *Physica Sacra* are lifelike enough that some hope of identification is possible on the basis of the images alone. Indeed, until the mid-19th century many herpetologists attempted to place Scheuchzer's images into the synonymies of the snakes then recognized (Table 2). Unfortunately for them, and for us, at the time that the plates were executed, the significance ventral and subcaudal scale counts, as first advocated by Linnaeus (1745 et seq.) and used by some other mid-18th century workers (e.g., Gronovius 1756), was not appreciated and so these useful pieces of information are not recorded in the images or in the text of the *Physica Sacra*. It was not until the work of Merrem (1790a, 1790b, 1809, 1810, 1821) that the utility of other scalation features, such as head scales and the condition of the anal plate was recognized and regularly figured accurately (Schmidtler 2006).

Because their scale counts could not be ascertained Linnaeus ignored many of the snakes illustrated by Scheuchzer, despite their otherwise largely accurate portrayal (Shaw 1802). However, other workers, many of whom had the benefit of having seen many snakes in other collections, attempted to place Scheuchzer's images into context (Table 2). Gronovius (1756) was the first to consistently reference Scheuchzer's (1735) images, but this work was

Plate 6. a. Match of (left) *Psammophylax rhombeatus* ($I2022A_3$) to (center) Scheuchzer (1735) plate 739, figure 7, and (right) *Icones* XXVI. Left and center images: A. M. Bauer. Right image courtesy of Universitätsbibliothek Leipzig. **b.** Match of (left) *Amphisbaena alba* ($I2046A_3$) to (top right) Scheuchzer (1735) plate 652, figure 1, and (bottom right) *Icones* XXXIV. Left and top right images: A. M. Bauer. Bottom right image courtesy of Universitätsbibliothek Leipzig.

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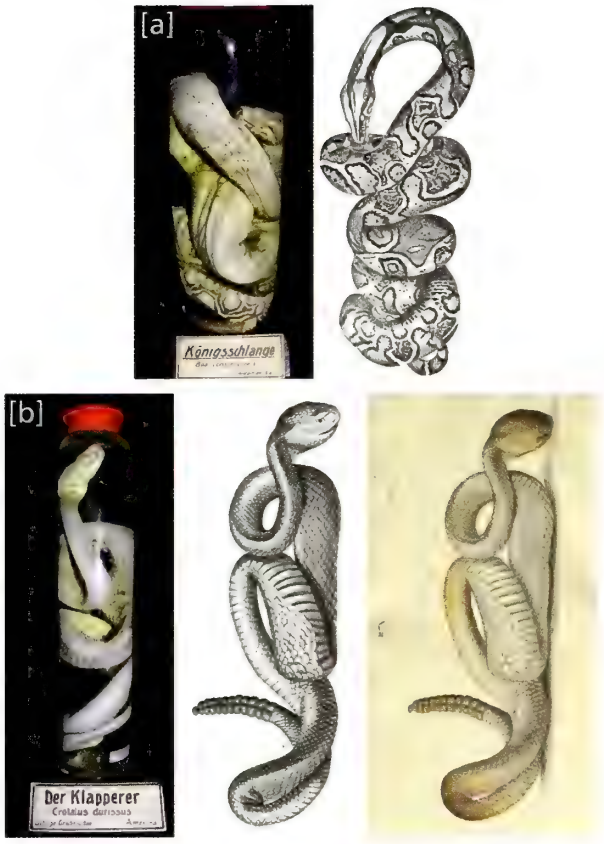

Plate 7. **a.** Match of (left) *Boa constrictor* (I2013A$_3$) to (right) Scheuchzer (1735) plate 746, figure 1. Photos: A. M. Bauer. **b.** Match of (left) *Crotalus durissus* (I2085A$_3$) to (center) Scheuchzer (1735) plate 738, figure 4, and (right) *Icones* XLII. Left and center images: A. M. Bauer. Right image courtesy of Universitätsbibliothek Leipzig.

itself pre-Linnaean and did not use binominal nomenclature. Selected images of Linck's snakes were subsequently cited by Linneaus (1758, 1766), Laurenti (1768), Gmelin (1789), La Cépède (1789), Bonnaterre (1790), Schneider (1801, 1821), Shaw (1802), and Daudin (1802a, 1802b, 1802c). Of these authors, only Schneider, who was based in eastern Germany and who had praised Linck and his collection (1792, 1797) is likely to have actually seen the specimens or perhaps at least the *Icones* (see footnotes Table 2). Merrem (1820) was the first author to formally place the majority of the Scheuchzer plates into the synonymy of recognized species. Boie (1827) in his critique of Merrem (1820) also commented on the identity of the Linck snakes. The most comprehensive evaluations of their identities, however, were made by Schlegel (1837) in his *Physionomie des Serpens*, a global review of snakes, and by Duméril & Bibron (1844) and Duméril et al. (1854a, 1854b) in *Erpétologie Générale*, the most detailed herpetological treatise produced to that time (Table 2). These authors largely agreed on identifications, although there were some differences of opinion and some images were regarded as being too imprecisely drawn to allow unambiguous identification.

We used the identifications of previous authors as a guideline for our own determinations of Scheuchzer's figures, but did not restrict our considerations to these taxa. We also compiled lists of possible subjects based on our own knowledge of snakes and obtained suggestions from a panel of colleagues (see Acknowledgements) with broad familiarity of snake systematics and identification. Ultimately our identifications as given in Table 2 were the result of comparisons of the plates with photographs and specimens of all candidate taxa compiled. In some instances no identifrication was possible. In a majority of cases we could confirm that the identifications of Duméril & Bibron (1844) and Duméril et al. (1854a, 1854b) were correct. As predicted for an early 18th century reptile collection, virtually all of the specimens represent species occurring in parts of the world to which access was controlled by the Dutch, who were the source of most commercially traded exotic natural history objects at the time. In particular, the greatest part of the collection is represented by South American species that would likely have been collected in Suriname. However, South African (Cape) species, such as *Causus rhombeatus*, *Psammophylax rhombeatus*, and *Pseudaspis cana* are represented, as

Plate 8. **a.** Match of (left) *Boiga dendrophila* (I2068A$_3$) to (top center) Scheuchzer plate 662, figure 11, (bottom center) *Icones* XLV, (top right) Seba (1735) Plate 21, figure 1, and (bottom right) illustration in Shaw (1802). Bottom center image courtesy of Universitätsbibliothek Leipzig. All other images: A. M. Bauer **b.** Match of (left) *Helicops angulatus* (I2014A$_3$) to (right) *Icones* plate LXXXIII. Left photo: A. M. Bauer. Right image courtesy of Universitätsbibliothek Leipzig.

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are Sri Lankan (Ceylonese) snakes, including *Cylindrophis maculatus*, *Amphiesma stolatum*, and *Chrysopelia ornata*, and those from Indonesia (former Dutch East Indies), e.g., *Cylindrophis ruffus*, *Boiga dendrophila*, and *Homalopsis buccata*.

IDENTIFICATION OF ORIGINAL LINCK SPECIMENS

We examined the entire collection of the amphibian and reptile specimens present in the Waldenburg collection in 2005 and 2009. These are arranged chiefly in two glass-fronted wooden cabinets and are in numbered aisles 52, 53, 56 and 57. Additional specimens are on display in the Linck Room and in the stairwell between the two main floors of the building. Unfortunately, the specimen labels, including red labels meant to denote Linck specimens identified in the reorganization of the 1930s, are attached to small wooden bases on which the jars stand (Plate 5d). The jars are weakly glued to the bases and in some cases were loose and in many cases these bases were clearly associated with the wrong specimens. There are no tags or other identifiers associated with the specimens within. However, each jar bears a small, uniquely numbered label, added in the 1993/1994 reorganization of the collection. None of the specimens in the stairwell display case was associated with a numbered label or a labeled base nor were several of the dry preparations in the Linck Room. Photographs were taken for subsequent confirmation of identification and comparison with Scheuchzer's (1735) plates but these were of limited use as all fluid-preserved specimens were sealed with a glass plate and covered in picein from the 1993–94 inventory and reorganization, requiring that photos were taken through the glass. Identification methods were the same as for the Scheuchzer plate images (see above).

We examined the eight specimens that had been previously identified as deriving from the Linck collection by Konstantin Wöpke during his reorganization in the 1930s (Table 4). Because only snakes and other reduced limbed reptiles and amphibians (amphisbaenians and caecilians) were figured by Scheuchzer, we had no way of confirming the lizards indicated as being part of the original Linck collection. However, we compared all the snake and amphisbaenian specimens now present in the Waldenburg collection, including those without red labels, to the published plates of Scheuchzer and to the original illustrations prepared by Linck in the *Icones*. Linck's images and the Scheuchzer plates are consistent with one another with respect to the approximate body positions of the snakes figured and we believe these to be accurate representations of the specimens as they appeared to Linck. Thus, we considered specimens showing the same body positions and color patterns to be possible matches. We found plausible matches for three of the red-labeled specimens (*Ahaetulla prasina*; *Liophis lineatus*; *Psammophylax rhombeatus*, Plate 6a). In addition, seven specimens not indicated by Wöpke's red labeling were considered matches to Scheucher figures (*Amphisbaena alba*, Plate 6b; *Boa constrictor*, Plate 7a; *Croatalus durissus*, Plate 7b; *Boiga dendrophila*, Plate 8a; *Corallus hortulanus*; *Thamodynastes pallidus*; *Naja naja*) and one additional specimen corresponds to a plate in the unpublished *Icones* but was not subsequently illustrated in *Physica Sacra* (*Helicops angulatus*, Plate 8b). Thus, if our identifications are correct, 11 of the specimens illustrated in the *Icones* and 10 figured by Scheuchzer (1735) appear to be extant (Table 4). It is certainly possible that additional, unfigured specimens of spirit-preserved snakes, as well other reptiles and amphibians, both dry and in fluid, may also date from this time, but this cannot be confirmed based on the evidence available.

One of the surviving specimens, here identified as *Boiga dendrophila* (and more specifically as *B. d. occidentalis* by Wallach 2012), has long been a source of contention. Shaw (1802) noted that this same specimen was figured by Seba (1735, pl. 21, fig. 1) and by Scheuchzer (1735, pl. 630 [sic]) and reproduced the image himself (Plate 8a). Merrem (1821) correctly cited the image as plate 662, figure 11 in Scheuchzer and considered that the similarity of the figures indicated that one of the authors had plagiarized the other. He concluded that it is Seba who had copied without attribution and indeed accused Seba of lying in claiming that he had received the snake from "a friend with good standing in society, who greatly valued it." In fact, given that Linck had initially provided Seba with images of his snakes (see above), no plagiarism of Scheuchzer is implied, although it may be argued that Seba misrepresented the specimen figured as being part of his own collection. Johann Heinrich Linck the elder himself, felt ill-used by Seba, who kept Linck's snake illustrations for half a year and copied them in association with a planned co-authored work on snakes, but ultimately decided to publish on his own (Zentralbibliothek Zürich Ms. H 304).

THE OLDEST FLUID-PRESERVED HERPETOLOGICAL COLLECTIONS

The Linck collection is of both historical and taxonomic relevance. The majority of the specimens that can be associated with some assurance to the *Index* of the 1780s, the *Icones* watercolors in Leipzig, or the plates of the *Physica Sacra*, are important as links to one of the most important German herpetological collections of the 18th century. At least those 11 specimens that can be matched to the *Icones* and Scheuchzer's plates must have been in the Linck collection at least since 1729 (Linck noted in March

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1730 that Seba had kept the drawings of snakes he had sent from Easter to Michaelmas, presumably of the previous year; Zentralbibliothek Zürich Ms. H. 304) making them among the oldest fluid-preserved herpetological specimens in the world.

Nehemiah Grew (1641–1712) was one of the first to report on anatomical specimens preserved in fluid, among them some of Boyle's earliest preparations (Jahn 1994) – including a snake, in his catalogue of the Royal Society Museum (Grew 1681). Some of these specimens were still extant more than a century later (Dobson 1956), but much of the early spirit-preserved material is known to have degraded by the first third of the 19th century (Select Committee 1835; Whitehead 1969). An illustration, made in 1703, of the collection of Levinus Vencent (MacGregor 2007, fig. 51) clearly shows jars of spirit preserved specimens, amongst them lizards, turtles and frogs. Other large herpetological collections were assembled by James Petiver (1663–1718) and Theodor Jakob Klein (1685–1759), as well Sir Hans Sloane (1660–1753), who ultimately incorporated Petiver's collection into his own. However, no fluid-preserved herpetological specimens are believed to be extant from any of these collections (although records of what once existed in Sloane's collection are held by The Natural History Museum, London (Clutton-Brock 1994)).

Despite the relative stability of fluid-preserved specimens, most private herpetological collections dating to before the middle of the 18th century were eventually destroyed or greagtly diminished by fire, jar breakage, alcohol evaporation, or simply curatorial neglect or indifference. Royal or national collections fared somewhat better, as they were less likely to suffer some of these vicissitudes, but even the oldest of these, the Swedish Museum of Natural History (with collections dating from 1739), is younger than the Linck collection.

It is impossible to determine the actual age of the snakes figured in the *Physica Sacra* and today housed in the Naturalienkabinett Waldenburg, as no records exist that document any herpetological portion of the Linck collection prior to 1730, the year in which Scheuchzer's plates are believed to have been executed (Seifert 1934). However, the collection of snakes was large and well-known several years earlier (Kanold in Neickelius 1727) and it is certainly conceivable that some specimens could date back to the period of Heinrich Linck, and perhaps to as early as the 1680s, by which time spirit-preservation of reptiles had become common.

A similar lack of temporal precision applies to the few other collections of comparable age. Thus, specimens in the collection of the Franckesche Stiftungen in Halle, despite its late 17th century origins, cannot be accurately dated beyond 1736, when Gotfried August Gründler (1710–1775) catalogued and reorganized the existing collection there. The Seba collection likewise can only be dated approximately, with specimens having been obtained between 1716, the year of the sale of Seba's first collection (of which no spirit-preserved material is known to survive), and about 1735, the year in which the second of the two volumes of Seba's *Thesaurus* that contain herpetological specimens was published. The surviving material from all three collections could therefore be approximately the same age, but the material from the Linck collection can be explicitly proven to date to at least 1729 (versus 1736 for specimens in Halle and 1734–35 for the now scattered specimens from Seba's collection) and has the potential for the greatest possible age, given that Heinrich Linck began his collection more than 25 years before the foundation of the Franckesche Stiftungen, when Albertus Seba was only a child.

Unfortunately, none of the type specimens from the Linck collection appear to be among the surviving specimens in Waldenburg. Even if all of the putative Linck specimens identified by Wöpke are among the extant specimens and the majority of other herpetoloigical specimens also date from at least the time of Johann Heinrich Linck the Younger, it is clear that the vast majority of this once massive collection has been lost or destroyed over the years. It is probable that many were either sold by Rhode prior to the purchase of the rest of the collection by Otto Victor and have subsequently become lost or destroyed, or that they deteriorated and were destroyed at some point prior to the collection reorganization of the 1930s. Indeed, the value of such historical specimens was generally not appreciated until late in the 19th century, resulting in extensive losses in the name of curation (Steinheimer 2005). There is a remote possibility that additional specimens illustrated by Scheuchzer (1735) and therefore dating from the time of Johann Heinrich Linck the Elder, potentially even some of the missing types, may yet be identified if specimens sold by Rohde can be identified in other collections.

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APPENDIX

Table 1. Herpetological material in the Linck collection as listed in the *Index Musae Linckiani* (1783–1787). Binominal names used in the *Index* are from the 12th edition of the *Systema Naturae* (Linnaeus 1766) and reflect the identifications of Johann Heinrich Linck the Younger. Specimens differing from the typical named forms in size, color, or provenance were listed by Linck immediately following the species they most closely resembled. *Index* page refers to the volume (I: 1783; III: 1787) and page number in the *Index* upon which each species or variety account begins. Specimen numbers alone refer to spirit-preserved material, "aufgeh." (aufgehängt = hung) or "trocken (= dry) aufgeh." refers to preparations hanging on a wall or from the ceiling, "Schubl." refers to dry preparations in drawers (Schubladen). Linck provided citations to the corresponding page number in Linnaeus (1766), as well as to corresponding images in Scheuchzer (1735; see Table 2), Seba (I: 1734, II: 1735), and Müller (as Müll. or Müllers Ueb. or Uebers.; III: 1774, Suppl.: 1776) and mentions in Ray (1693) and Laurenti (1768). Information in this table may be cross-referenced with that in Table 2 by comparing the **Specimen numbers** columns.

***Index* name**	***Index* Page**	**Specimen numbers**	**Linnaeus 1766**	**Other Citations**
Testudo coriacea	I:61	aufgeh. 98, 25, Schubl. No. 6	350	
Testudo imbricata	I:61	aufgeh. 100a	350	
Testudo mydas	I:61	trocken aufgeh. 95, 96	350	
Desgl. eine von der nemlichen Art, aber kleiner	I:61	326, 327, trocken aufgeh. 97		
Testudo orbicularis	I:61	25 Schubl. No. 5	351	
Desgl. nur die Oberschaale	I:61	aufgeh. 100b		
Testudo scabra	I:61	25 Schubl. No. 4, aufgeh. 100	351	
Testudo scorpioides	I:61	aufgeh. 99	352	
Testudo graeca	I:62	25 Schubl. No. 2	352	
Testudo carolina	I:62	25 Schubl. No. 8	352	
Testudo geometrica	I:62	25 Schubl. No. 1,3	353	Müllers Uebers. T. III. T. XII, f. 1
Noch eine Verschiedenheit von der *Geometrica*	I:62	25 Schubl. No. 9	353	
Testudo pusilla	I:62	25 Schubl. No. 7	353	
Rana pipa	I:62	322–325	354	Müllers Ueb. T. III. T. XII, f. 2
Desgleichen ein Exemplar woran man die aufgesprungenen Eyer recht genau beobachten kann	I:62	321		
Rana musica	I:62	303	354	
Rana bufo	I:62	320	354	
Rana gibbosa	I:63	310, 311, 319	355	Seb. II, 37-3
Rana bombina	I:63	312	355	
Rana ventricosa	I:63	309	355	
Ein kleinerer	I:63	318		
Rana marina Americana	I:63	316	356	
Rana ocellata	I:63	315	356	Seb. I, 76-1
Rana marginata	I:63	297	356	
Rana paradoxa	I:63	293, 294, 294A–C	356	Seb. I, 78-6,16,21
Rana temporaria	I:63	302	357	
Rana arborea	I:63	295, 296, 298–301, 305, 306; 27 Schubl. No. 5	357	
Dergleichen ein ganz großer weißer Surinamischer Laubfrosch	I:63	307		
Einer dergleichen mit einem Fusse	I:63	304		
Rana boans	I:64	308	358	
Dergleichen Art aus Surinam	I:64	313		
Dergleichen aus Brasilien	I:64	314		
Dergleichen aus Carolina	I:64	317		Phil. Trans. 210:215
Draco volans	I:64	439–442, 27 Schubl. No. 2	358	Müllers Ueb. T. III. T. I, f. 4
Desgleichen die Amerikanische fliegende Eidechse	I:64	443–447	358	Müllers Ueb. T. III. T. I, f. 5

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***Index* name**	***Index* Page**	**Specimen numbers**	**Linnaeus 1766**	**Other Citations**
Lacerta crocodilus	I:64	328–334, 336, 340	359	Seb. I, 103, 104, 106
Dergl. noch einige junge afrik. Krocodile	I:65	335, 337–339		
Lacerta superciliosa	I:65	72, 374, 449, 450	360	Seb. I, 1-9-24
Lacerta monitor	I:65	343–349	360	Seb. I, 94-1-3
Lacerta principalis	I:65	417	360	
Lacerta cordylus	I:65	341, 391, 393	361	
Desgl. Aus Amerika	I:65	392, 27 Schubl. No. 7		
Lacerta mauritanica	I:66	458	361	
Lacerta azurea	I:66	342	362	Seb. II, 62-6, 97-4
Lacerta turcica	I:66	456	362	
Lacerta ameiva	I:66	376-384, 384, 412, 419, 27 Schubl.	362	Seb. I, 88-2
Desgl. eine mit getheilten Schwanze	I:66	398		
Desgl. eine Verschiedenheit	I:66	394, 395, 413		Seb. I, 85-2-4, 86-4
Lacerta agilis	I:66	375, 397, 403–405, 407, 418, 428, 429	363	Seb. II, 79-5, 4-5
Desgl. mit einem länglichen Auswuchse auf der Oberseite des Schwanzes	I:66	386		
Lacerta seps	I:66	399	363	
Lacerta de taletec. min. mas et foem.	I:66	409, 410		Seb. I, 79-1
Noch eine Amerikanische	I:67	406, 27 Schubl.		Seb. I, 92-5
Lacerta chamaeleon	I:67	433, 435, 436, 438, 438A, 27 Schubl. No. 3	364	Seb. I, 82-1-5, 83-5
Dergl. Ein Exemplar aus Morea	I:67	437		
Lacerta gecko	I:67	452, 455, 457, 459–461, 27 Schubl. No. 6	365	Seb. I, 108
Lacerta stincus	I:67	400–402	365	Seb. I, 105-3
Lacerta orbicularis	I:67	424, 451	365	Seb. I, 109-6
Lacerta ypsilon	I:68	290A		
Lacerta iguana	I:68	350, 351, 353–363	366	Seb. I, 96-4,5, 97-3, 98-1
Lacerta calotes	I:68	364–371, 373, 396	367	
Lacerta agama	I:68	448	367	Seb. I, 107-1-3
Lacerta marmorata	I:68	385, 387–390, 414–416, 434	368	Seb. II, 76-4
Lacerta teguixin	I:68	420, 421, 423, 425–427	368	
Die größte *Teguixin*	I:68	352		
Lacerta punctata	I:68	430, 432	369	
Lacerta chalcides	I:69	431	369	
Lacerta lemniscata	I:69	408, 422	369	
Lacerta arguta	I:69	411		Müll. Uebers. im Suppl. Bande p. 188.41.A)
Noch verschiedene Eidechsen	I:69	264, 579, 27 Schubl. No. 1, 4		
Lacerta aquatica	I:69	453	370	Seb. II, 12-7
Lacerta palustris	I:69	454	370	Seb. I, 89-4,5
Lacerta salamandra	I:69	462–468	371	Seb. II, 15-5
Crotalus miliaris Lin.	I:70	469	372	
Crotalus dryinas Lin.	I:70	563	372	Seb. II 95-3
Crotalus durissus Lin.	I:70	553	372	Seb. II 95-2
Boa hipnale Lin.	I:70	671	373	Seb. II 34-2
Boa constrictor Lin.	I:71	669–670	373	
Boa hortulana Lin.	I:71	661–662	374	
Eine mit braunen Bändern	I:71	488		
Coluber vipera Lin.	I:71	552	375	
Coluber atropos Lin.	I:71	540	375	
Coluber plicatilis Lin.	I:71	564	376	
Coluber domicella Lin.	I:71	530	376	
Coluber buccatus Lin.	I:72	651–652	377	
Coluber berus Lin.	I:72	609	377	
Desgl. die surinamische Natter	I:72	499		
Coluber angulatus Lin.	I:72	502	377	
Eine aus Ceylon dergl.	I:72	503, 654		

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Index name	*Index* Page	Specimen numbers	Linnaeus 1766	Other Citations
Coluber aspis Lin.	I:72	690	378	
Coluber lebetinus Lin.	I:72	576	378	
Coluber melanocephalus Lin.	I:72	574–575, 578, 673	378	
Coluber reginae Lin.	I:72	580–581	378	
Coluber severus Lin.	I:73	668	379	
Coluber aurora Lin.	I:73	565	379	
Coluber stolatus Lin.	I:73	679	379	
Coluber vittatus Lin.	I:73	676–678	380	Seb. T. 661.8[1]
Coluber aesculapii Lin.	I:73	483–484	380	
Desgl. aus Afrika	I:73	491, 493–494, 587		
Desgl. Eine sehr grosse dieser Art	I:73	649		
Desgl. noch verschiedene	I:73	486–487, 560		
Noch eine Verschiedenheit	I:73	485, 592		
Coluber rhombeatus Lin.	I:73	482, 562	380	
Coluber cyaneus Lin.	I:73	635–636	380	
Coluber natrix Lin.	I:73	473	380	Seb. II. 35-4
Dergl. eine aus Surinam	I:74	475–481, 542		
Dergl. kleinere	I:74	548–549, 554, 556–558, 614, 680		
Dergl. vom Vorgeb. der guten Hoffnung viel verschiedene Arten	I:74	471–472, 500–501, 504–508, 520–529, 531, 537, 539, 545–547, 666, 681–683	375	
Coluber agilis Lin.	I:74	655	381	
Coluber lacteus Lin.	I:74	534	381	
Coluber jaculatrix Lin.	I:74	643	381	
Coluber pallidus Lin.	I:74	519, 536, 566	381	
Coluber lineatus Lin.	I:74	551, 642, 644	382	
Coluber naja Lin.	I:74	645	382	Seb. II. 94-1
Dergl. noch verschiedene	I:74	646–648		Seb. I. 44-1
Coluber padera Lin.	I:75	689	382	
Coluber canus Lin.	I:75	541, 573	382	
Coluber sibilans Lin.	I:75	685	383	
Coluber atrox Lin.	I:75	538	383	
Coluber nebulatus Lin.	I:75	509–512, 516–517	383	
Dergl. kleinere	I:75	513–514		
Coluber fuscus Lin.	I:75	664–665	383	
Dergleichen von heller Farbe	I:75	474		
Dergleichen von brauner Farbe	I:75	470		
Coluber saturninus Lin.	I:75	561	384	Seb. II. 1-8
Coluber corallinus Lin.	I:75	24 Schubl. No. 2	384	
Coluber exoletus Lin.	I:75	638	385	
Coluber lemniscatus Lin.	I:76	495, 585–586	386	
Coluber annulatus Lin.	I:76	535, 695	386	
Dergl. Eine Varietaet von der Annulata	I:76	686		
Coluber aestivus Lin.	I:76	633	387	
Coluber ahaetulla Lin.	I:76	618–628, 637	387	
Eine dergl. Kleine Art mit schwarzen Flecken	I:76	629		
Coluber petalarius Lin.	I:76	496	387	Seb. II. 16-2
Coluber haie Lin.	I:76	684[2]	387	
Coluber dipsas	[I:76]	[684] [2]		
Coluber filiformis Lin.	I:76	640	388	
Coluber pullatus Lin.	I:76	667	388	
Coluber hippocrepis Lin.	I:76	543, 567–568	388	
Coluber cinereus Lin.	I:76	555	388	
Coluber mucosus Lin.	I:77	641	388	
Coluber cenchoa Lin.	I:77	656, 663, 688, 691	389	
Noch dergl. verschiedene	I:77	515, 653, 657–660		
Dergl. eine Varietät	I:77	692–694, 696		
Coluber mycterizans Lin.	I:77	631	389	
Dergl. Pfirschblüthfarbne, aus Ceylon	I:77	616–617		
Dergl. große blaue und grüne	I:77	634		
Dergl. ganz dunkelblaue	I:77	639		

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Index name	*Index* Page	Specimen numbers	Linnaeus 1766	Other Citations
Eine, welche die schönsten Farben wie ein Opal spielt, aus Surinam	I:77	630, 632		
Coluber coerulescens Lin.?	I:77	675	389	
Coluber reticulatns	I:77	533		
Coluber, s *Vipera maculata*	I:77	672		Laurenti ?
Coluber, s. *Vipera americana, variis characteribus orientalibus inscriptus*	I:77	518		Raj [Ray]
Noch verschiedene Nattern, vom Capite bonae spei	I:78	569		
Noch verschiedene Arten aus verschiedenen Ländern	I:78	492, 532, 544, 550, 570, 24 Schubl.		
Anguis meleagris Lin.	I:78	572	350	Seb. II. 21-4
Anguis maculata Lin.	I:78	599	391	
Anguis reticulata Lin.	I:78	608	391	
Anguis laticauda Lin.	I:78	559	392	Seb. II. 30-3
Anguis scytale Lin.	I:78	489–490, 582–584	392	
Dergleichen etwas kleiner	I:78	497–498, 588–590		
Dergleichen noch kleiner	I:78	591, 611–612		
Noch eine Verschiedenheit aus Amerika	I:79	593–595		
Anguis americ. ex albo sub nigro tessellatus	I:79	600, 650		
Anguis eryx Lin.	I:79	610	392	
Anguis fragilis Lin.	I:79	577, 687	392	
Amphisbaena fuliginosa Lin.	I:79	596–598, 615	392	
Dergleichen	I:79	601–606		
Amphisbaena alba Lin.	I:79	607	393	
Caecilia tentaculata Lin.	I:79	571, 613	393	Seb. II. 25-2
exuvia boae contortricis	I:80	aufgeh. 102		
exuvia boae contortricis	I:80	aufgeh. 101		Seb. I. 53-1
exuvia boae contortricis	I:80	127 Schubl.		
coronae serpentis	I:80	175 Schubl. No. 6		
lapidees serpentini magnetici	I:80	175 Schubl. No. 8		
spina dorsalis serpentis	I:80	175 Schubl. No. 4		
ova serpentis	I:80	697A		Seb. I. 7
ova serpentis	I:80	17 oder 18 Schubl.		
ova lacertae crocodilli	I:81	17 Schubl. No. 4		
ova testudinis	I:81	17 Schubl. No. 5		
Coluber coerulescens Lin.	I:276, III:248	674		
Coluber aspis aegyptiaca	III:248	818		Seb. II.188-1 [sic, prob. 88-1]
Coluber Indicus putorius gryseo-luteus	III:248	817		

[1]This reference to Seba by Linck is a lapsus or printer's error. The "661.8" actually corresponds to the plate (661) and figure (8) in Scheuchzer (1735) and the intended citation would have been "Sch. T. (Tafel = plate) 661.8".
[2]In the University of Leipzig copy of the *Index* annotated by J. H. Linck the Younger specimen number 684 is crossed-out in association with *Coluber haie* and a note has been added on the facing blank page indicating that this specimen should be associated with *Coluber dipsas*, figure 5 on plate 738 in Scheuchzer (1735).

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Table 2. Identification of the snakes and amphisbaenians illustrated in Scheuchzer's *Physica Sacra*. *Icones* Roman numeral plate numbers correspond to Arabic numeral 'Mus. Linck.' numbers that appear on the published plates in Scheuchzer (1735). Gronovius (1756), Merrem (1820), Schlegel (1837), Duméril & Bibron (1844), and Duméril et al. (1854a, 1854b) provided the greatest number of citations to Scheuchzer's plates. Other citations from the period 1758–1858 are summarized by name employed. 'Current Identification' reflects the authors' best interpretation of the identity of Scheuchzer images based on extensive comparisons with specimens and photographs (see text). Current names in bold are specimens positively identified as appearing in the corresponding Scheuchzer plate. Information in this table may be cross-referenced with that in Table 1 by comparing the **Specimen numbers** columns.

Physica **Plate-Fig.**	***Sacra*** **Text pages**	***Icones*** **Plate n°**	***Index*** **Specimen n°**	**Gronovius (1756)**	**Merrem (1820)**	**Schlegel (1837)**	**Duméril & Bibron (1844) Duméril et al. (1854a,1854b)**	**Other Identifications**	**Identifications of Image**
606-A	1087	LXV	817	44	*Boa murina*	*Boa murina*	*Eunectes murinus*	*Boa murina* (Schneider 1801, 1821; Daudin 1802a; Merrem 1810)	*Eunectes murinus*
606-B	1087	LXVII (part)[1]		5	*Tortrix maculata*	*Tortrix maculata*	*Cylindrophis maculata*	*Anguis maculatus* (Schneider 1801; Daudin 1802c)	*Cylindrophis maculatus*
606-C	1087	LXVII (part)		13	*Coluber (Natrix) ornatus*	*Dendrophis ornata*	*Chrysopelea ornata*	*Chrysopelea ornata* (Boie 1827; Wagler 1830; Günther 1858); *Leptophis ornatus* (Cantor 1847)	*Chrysopelia ornata*
628-A	1178–79	XI	475–481, 542		*Coronella reginae*	*Liophis reginae*			*Liophis reginae*
628-B[2]	1179	LVI	582	4	*Tortrix scytale*		*Tortrix scytale*	*Anguis corallinus* (Schneider 1801; Daudin 1802c); *Tortrix scytale* (Gray 1849)	*Anilius scytale*
628-C	1179	XXXVII	609		*Pelias Berus*				*Vipera berus*
628-D[3]	1179	XV	601–606[4]	2	*Amphisbena fuliginosa*		*Amphisbaena fuliginosa*	*Amphisbaena fuliginosa* (Bonnaterre 1790; Schneider 1801)	*Amphisbaena fuliginosa*
628-E	1179–80	X	671		*Boa canina*	*Boa canina*	*Xiphosoma caninum*	*Boa isebequensis* (Bonnaterre 1790); *Boa hypnale* (Schneider 1801, 1821; Daudin 1802a); *Boa aboma* (Daudin 1802a); *Xiphosoma caninum* (Gray 1849)	*Corallus caninus*
629-F	1180	XXX	600, 650		*Tortrix rufa*	*Tortrix rufa*	*Cylindrophis rufa*	*Anguis rufus* (Schneider 1801); *Tortrix rufa* (Boie 1827); *Cylindrophis rufa* (Gray 1849)	*Cylindrophis ruffus*
629-G[5]	1180	LV	643			*Dendrophis picta*	*Dendrophis picta*	*Coluber gliricapa* (Bonnaterre 1790); *Dendrophis pictus* (Boie 1827)	*Dendrelaphis pictus*
630-A[6]	1180	XL	530, 616, 617	19	*Coluber (Natrix) fulgidis*	*Dryophis* sp.	*Tragops prasinus*		*Oxybelis fulgidus*
630-B[7]	1180	L	502		*Coluber (Natrix) angulatus*	*Helicops angulata*	*Helicops angulatus*	*Coluber angulatus* (Merrem 1821); *Uranops angulatus* (Gray 1849)	*Helicops angulatus*
647-1	1283	XXIX	533		*Scytale Scheuchzeri*	*Tortrix rufa*	*Cylindrophis rufa*	*Tortrix rufa* (Boie 1827); *Cylindrophis rufa* (Gray 1849)	*Cylindrophis ruffus*
647-2[8]	1283	XXXIX	518			*Lycodon audax*	*Lycognathus scolopax*		*Siphlophis cervinus*
647-3	1283	LIX	not in *Index*			*Dipsas catesbyi* ?			*Dipsas variegata*?
648-1	1286	XXIV	553	45	*Cophias Jararaca*	*Crotalus* sp.	*Bothrops jararaca*	*Crotalus horridus* (Boie 1827)	*Crotalus durissus*
648-2[9]	1286	LVIII	485, 592		*Elaps corallinus*	*Elaps lemniscatus*	*Erythrolamprus venustissimus* *Elaps lemniscatus*	*Elaps lemniscatus* (Günther 1858)	*Oxyrhopus* sp.?
652-1[10]	1295	XXXIV	607		*Amphisbaena alba*		*Amphisbaena alba*	*Amphisbaena alba* (Gmelin 1789; Schneider 1801)	***Amphisbaena alba***

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Physica Plate-Fig.	*Sacra* Text pages	*Icones* Plate n°	*Index* Specimen n°	Gronovius (1756)	Merrem (1820)	Schlegel (1837)	Duméril & Bibron (1844) Duméril et al. (1854a,1854b)	Other Identifications	Identifications of Image
652-2	1295	LXIII	535, 695	17	*Coluber (Natrix) annulatus*	*Dipsas annulata*	*Dipsas annulata*	*Coluber purpurascens* (Bonnaterre 1790); *Leptodeira annulata* (Günther 1858)	*Leptodeira annulata*
653-1[11]	1296	XVIII	635, 636		*Coluber (Natrix) viridissimus*	? *Herpetodryas* sp.			*Philodryas viridissima*
653-2	1296	XX	564		*Coluber (Natrix) plicatilis*	*Homalopsis plicatilis*	*Calopisma plicitile*	*Elaps plicatilis* (Schneider 1801); *Coluber plicatilis* (Merrem 1821)	*Pseudoeryx plicatilis*
653-3[12]	1296	XXI	499			*Helicops angulata?*	*Helicops angulatus*	*Uranops angulatus* (Gray 1849)	?
654-4	1296	XXVII	486, 487, 560		*Coluber (Natrix) agilis*	*Coronella venustissima*	*Erythrolampus aesculapii*	*Coluber agilis* (Merrem 1821)	*Erythrolamprus aesculapii*
654-5	1296	LIV	541, 573			*Lycodon petolarius*	*Dipsadomorphus indicus*	*Coluber aesculapii* (Gmelin 1789)	*Dipsas indica*
655-6	1296–97	VII	672				*Lycodon aulicum*		*Lycodon aulicus* ?
655-7	1297	XIII	631			*Dryophis* sp.			***Ahaetulla prasina***
655-8.	1297	XXII	488		*Bungarus annularis*	*Bungarus annularis*	*Bungarus annularis*	*Pseudoboa fasciata* (Schneider 1801, 1821); *Bungarus annularis* (Daudin 1802a); *Bungarus fasciatus* (Cantor 1847; Günther 1858)	*Bungarus fasciatus*
657-1	1302	XVI	618–628, 637						?
657-2	1302	XXV	534			*Dipsas multimaculata*	*Dipsas multimaculata*	*Elaps lacteus* (Schneider 1801); *Dipsas multomaculata* (Boie 1827); *Dipsas multimaculata* (Cantor 1847)	*Boiga multomaculata*
660-1	1311	I	651, 652	25	*Vipera (Echidna) semifasciata*	*Homalopsis buccata*	*Homalopsis buccata*	*Homalopsis buccata* (Cantor 1847)	*Homalopsis buccata*
660-2	1311	II	not in *Index*						?
660-3[13]	1311	III	593–595[14]			*Tortrix maculata*	*Cylindrophis rufa*	*Amphisbaena alba* (Bonnaterre 1790); *Tortrix rufa* (Boie 1827)	*Cylindrophis ruffus*
660-4[15]	1311	IV	556						?
660-5[16]	1311	V	471, 472, 501, 504–507, 520–529, 531, 537, 539, 545–547, 666, 681–683[17]			*Coronella cobella*	*Liophis cobella*	*Coluber cobella* (Merrem 1821)	*Liophis reginae*
660-6	1311–12	VI	515, 653, 657–660			*Dipsas catesbyi*			*Dipsas catesbeii* ?
660-7[18]	1312	IX	668		*Coluber (Natrix) versicolor*	*Xenodon severus*	*Xenodon severus*	*Coluber guineensis* (Bonnaterre 1790); *Ophis severus* (Wagler 1830)	*Xenodon severus*
661-8[19]	1312	XIV	676–678	31	*Coluber (Natrix) vittatus*	*Tropidonotus vittatus*	*Tropidonotus vittatus*	*Tropidonotus vittatus* (Günther 1858)	*Xenochrophis vittatus*
661-9	1312	XVII	661		*Boa hortulana*	*Boa hortulana*		*Boa hortulana* (Schneider 1801; Daudin 1802a); *Corallus hortulanus* (Gray 1849)	***Corallus hortulanus***
662-10	1312	XXXVI	685			*Homalopsis plicatilis* ?			?
662-11[20]	1312	XLV	538	12	*Coluber (Natrix) Caninana*	*Dipsas dendrophila*	*Triglyphodon dendrophilum; Spilotes variabilis*	*Coluber Peruvianus* (Shaw 1802); *Coluber pantherinus* (Merrem 1821); *Dipsas dendrophila* (Boie 1827; Cantor 1847; Günther 1858); *Spilotes variabilis* (Günther 1858)	***Boiga dendrophila***

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Physica Plate-Fig.	*Sacra* Text pages	*Icones* Plate n°	*Index* Specimen n°	Gronovius (1756)	Merrem (1820)	Schlegel (1837)	Duméril & Bibron (1844) Duméril et al. (1854a,1854b)	Other Identifications	Identifications of Image
678-1	1346	VIII	519, 536, 566			*Dipsas punctatissima*	*Dipsas punctatissima*		***Thamnodynastes pallidus?***
678-2	1346	XXXII[21]	591, 611, 612	4	*Tortrix scytale*	*Tortrix scytale*	*Tortrix scytale*	*Tortrix scytale* (Gray 1849)	*Anilius scytale*
678.3	1347	XLIX	656, 663, 688, 691		*Coluber (Natrix) cenchoa*	*Dipsas weigelii*	*Imantodes cenchoa*	*Dipsas cenchoa* (Günther 1858)	*Imantodes cenchoa*
678-4	1347	LX	679		? *Coluber (Natrix) stolatus*				*Amphiesma stolatum*
715-1	1429–30	XIX	565						*Enhydris enhydris*
715-2	1430	LIII	551, 642, 644	26	*Coluber (Natrix) lineatus*		*Dromicus lineatus*	*Coluber jaculatrix* (Gmelin 1789); *Coluber jaculus* (Daudin 1802c); *Dromicus lineatus* (Günther 1858)	***Liophis lineatus***
717-1[22]	1431	XXVIII	552			*Naja rhombeata*	*Causus rhombeatus*		*Causus rhombeatus*
717-2	1431	XLI	634		*Coluber (Natrix) fulgidis*		*Dryinus nasutus*		*Ahaetulla nasuta*
737-1	1493	XII	483, 484	10	*Scytale anguiformis;* ? *Elaps corallinus*	*Coronella venustissima*	*Erythrolamprus vensustissimus; Erythrolampus aesculapii*	*Boa scytale* (Linnaeus 1758, 1766; Gmelin 1789; Lacépède 1789; Schneider 1801; Daudin 1802a; Shaw 1802); *Anguis scutata* (Laurenti 1768; Gmelin 1789)	*Erythrolamprus aesculapii* ?
737-2	1493	XXXV	574, 575, 578, 673		*Scytale coronata*		*Brachyruton cloelia*		*Clelia clelia* ?
737-3	1493	LXI	684[23]		*Coluber (Natrix) rhombeatus*	*Helicops angulata* ?	*Helicops angulatus*	*Elaps triangularis* (Boie 1827); *Uranops angulatus* (Gray 1849)	*Helicops angulatus* ?
738-4[24]	1493	XLIII	563		*Crotalus Dryinas*	*Crotalus* sp.			***Crotalus durissus***
738-5	1493	XLVII	[684][25]			*Coronella cobella*	*Liophis cobella*		*Liophis cobella* ?
738-6	1493–94	LVII	500, 508	32		*Coronella reginae*	*Liophis reginae, Liophis cobella*		*Liophis reginae*
739-7	1493–94	XXVI	482, 562			*Coronella rhombeata*	*Dipsas rhombeata*	*Coronella rhombeata* (Boie 1827)	***Psammophylax rhombeatus***
739-8	1493–94	XLVIII	692–694, 696		*Coluber (Natrix) Catesbeii*	*Dipsas catesbyi*	*Stremmatognathus catesbyii*	*Dipsas catesbeii* (Boie 1827)	*Dipsas catesbeii*
746-1	1532	XLIV	669, 670	43	*Boa constrictor*	*Boa constrictor*	*Boa constrictor*	*Boa constrictrix* (Schneider 1801); *Boa constrictor* (Merrem 1821; Gray 1849)	***Boa constrictor***
746-2	1532	XLVI	675		*Coluber (Natrix) cancellatus*	*Coronella reginae*	*Liophis reginae, Liophis merremii*	*Coluber rhombeatus* (Gmelin 1789; Daudin 1802c); *Coluber atro-reticulata* (Bonnaterre 1790); *Coluber crassicaudatus* (Boie 1827)	*Liophis miliaris* ?
747-3	1532	XXIII	667	12	? *Coluber (Natrix) Maximiliani*	*Coluber variabilis*	*Spilotes variabilis*	*Spilotes variabilis* (Günther 1858)	*Spilotes pullatus*
747-4[25]	1532	XXXIII	608	7	*Tortrix reticulata*	*Typhlops lumbricalis*	*Typhlops reticulatus*	*Anguis reticulatus* (Linnaeus 1758, 1766; Gmelin 1789; Schneider 1801; Daudin 1802c); *Typhlops lumbricalis* (Boie 1827)	*Typhlops reticulatus*
747-5	1532	LXIV	543, 567, 568			*Coluber canus*		*Coluber margaritaceus* (Merrem 1821); *Coronella cana* (Günther 1858)	*Pseudaspis cana*

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Physica Plate-Fig.	*Sacra* Text pages	*Icones* Plate n°	*Index* Specimen n°	Gronovius (1756)	Merrem (1820)	Schlegel (1837)	Duméril & Bibron (1844) Duméril et al. (1854a,1854b)	Other Identifications	Identifications of Image
748-6	1532	XXXI	599		*Tortrix rufa*	*Tortrix rufa*	*Tortrix rufa*	*Amphisbaena fuliginosa* (Bonnaterre 1790); *Anguis rufus* (Schneider 1801); *Eryx rufus* (Daudin 1802c); *Cylindrophis rufa* (Gray 1849)	*Cylindrophis ruffus*
748-7	1532	XXXVIII	655			*Lycodon petolarius*	*Oxyrhopus bipraeocularis*		*Lycodon aulicus* ?
748-8	1532	LII	509–512, 516, 517		*Coluber (Natrix) nebulatus*	*Dipsas nebulata*	*Petalognathus nebulatus*	*Coluber zeylonicus* (Gmelin 1789; Daudin 1802b); *Coluber nebulatus* (Merrem 1821)	*Sibon nebulata*
749-9	1532–33	XLII	646–648[26]		*Naia tripudians*	*Naja tripudiians*		*Coluber naja* (Bonnaterre 1790); *Naja tripudians* (Günther 1858)	***Naja naja***
749-10[27]	1533	LI	596–598, 615 2		*Amphisbena fuliginosa*		*Amphisbaenia fuliginosa*	*Amphisbaeba fuliginosa* (Bonnaterre 1790; Schneider 1801)	*Amphisbaena fuliginosa*
749-11	1533	LXII	540		*Cophias trigonocephalus*		*Bothrops nigro-marginatus*	*Megaera trigonocephala* (Gray 1849); *Trigonocephalus hypnale* (Gray 1849)	*Hypnale* sp. ?

[1]*Icones* plate LXVI is incorrectly cited on Scheuchzer's (1735) plate 606 as the source of image B instead of plate LXVII.
[2]This figure is not cross-referenced in the *Index*. Schneider (1801) and Daudin (1802) erroneously cite this figure as 268-B and the 'Mus. Linck.' number (= *Icones* plate) as 54 instead of 56.
[3]This figure is incorrectly cited as 628B by Bonnaterre (1790) and as 1129D by Duméril & Bibron (1844).
[4]The *Icones* plate references only specimens 601 and 602.
[5]This figure is incorrectly cited in the *Index* as 629-9 and by Bonnaterre (1790) and Boie (1827) as 629-6.
[6]In the *Index* plate 630, figure A is attributed to two different species: *Coluber domicella* (530) and *C. mycterizans* Dergl. Pfrischblüthfarbne, aus Ceylon (616, 617).
[7]Incorrectly cited as 360-B by Duméril et al. (1854a).
[8]Incorrectly cited as 647-1 by Duméril et al. (1854b).
[9]Incorrectly cited as 648-4 by Günther (1858).
[10]Incorrectly cited as figure 1152-1 by Duméril & Bibron (1844).
[11]Incorrectly cited as 647-1 by Schlegel (1837).
[12]Incorrectly cited as 630-3 by Duméril et al. (1854a).
[13]Incorrectly cited as 66-3 by Bonnaterre (1790) and as 660-1 by Boie (1827).
[14]The *Icones* plate references only specimens 593 and 595.
[15]This plate is not cross-referenced in the *Index*.
[16]This figure was incorrectly cited as 660-4 by Merrem (1821).
[17]The *Icones* plate references only specimens 471 and 472.
[18]Incorrectly cited as 640-7 by Merrem (this figure is incorrectly cited as Seb. (= Seba) T. 661-8 in the *Index*.
[20]Incorrectly cited as 662-2 by Boie (1827). According to Duméril & Bibron (1844) this image was copied after Seba, Tome I, Pl. 21, fig. 1. Merrem (1821), however, interpreted the similarity between the plates differently (see text).
[21]Reference to 'Mus. Linck' 32 (= *Icones* plate XXXII) is omitted from Scheuchzer's (1735) plate 678-2.
[22]This figure is cited only as 717 (without figure number) in the *Index*.
[23]In the University of Leipzig copy of the *Index* annotated by J. H. Linck the Younger specimen number 684 is crossed-out in association with plate 737-3 and a note has been added on the facing page indicating that this specimen should be associated with *Coluber dipsas*, figure 5 on plate 738.
[24]This plate is not cross-referenced in the *Index*.
[25]Bonnaterre (1790) copied this image but did not cite or credit Scheuchzer (1735) in his account of *Anguis reticulatus*.
[26]The *Icones* plate references only specimen 647.
[27]Incorrectly cited as 1249-10 by Duméril and Bibron (1844).

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Table 3. Identification of the snakes and lizard illustrated in plates of the *Icones* that do not correspond to published figures in Scheuchzer (1735). Correspondences to the Linck specimen numbers, species names, and Seba references as used in the *Index* (1783) are indicated as are subsequent references to the unpublished *Icones* plates. Current Identification reflects the authors' best interpretation of the identity of Scheuchzer images based on extensive comparisons with specimens and photographs (see text). Current name in bold is a specimen positively identified as appearing in the corresponding *Icones* plate.

Icones Plate n°	**Linck (1783) number**	**Name in Linck (1783)**	**Seba**	**Schneider (1801)**	**Daudin (1802)**	**Current Identific.**
LXVI[1]				*Elaps Duberria*		*Chrysopelia pelias*
LXVIII						unknown
LXIX						*Duberria lutrix* ?
LXX						*Crotalus durissus*
LXXI						*Coelognathus radiatus*
LXXII[2]	645	*Coluber naja* Lin.	Seb. II. 94-1			*Naja naja*
LXXIII						*Naja naja*
LXXIII						*Liophis reginae* ?
LXXIV						*Liophis cobella*
LXXV				*Anguis rufus*		*Cylindrophis ruffus*
LXXVI						unknown
LXXVII						*Ahaetulla prasina*
LXXVIII					*Eryx rufus*	unknown
LXXIX	641	*Coluber mucosus* Lin.				
LXXIX						*Ahaetulla prasina*
LXXX						*Crotalus* sp.
LXXXI						unknown
LXXXII						*Oxybelis aeneus*
LXXXIII						***Helicops angulatus***
LXXXIV	572	*Anguis meleagris* Lin.	Seb. II. 21-4	*Anguis meleagris*		*Acontias meleagris*
LXXXV	495, 585, 586	*Coluber lemniscatus* Lin.				*Micrurus lemniscatus*
LXXXVI						plate missing[3]
LXXXVII						unknown
LXXXVIII						unknowm
LXXXIX						typhlonectid caecilian
XC						*Spilotes pullatus*

[1] Scheuchzer plate 606 incorrectly indicates Mus. Linck. N. 66 (rather than 67) as the source of figure B.
[2] Mislabeled XLII in *Icones*.
[3] The Roman numerals associated with *Icones* plates LXXXV and XC are clearly visible, but there are no numbers on the three intervening plates. However, handwritten pagination is continuous across the associated pages, suggesting that one plate is missing. We interpret the missing plate as LXXXVI.

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Table 4. Specimens of reptiles in the Naturalienkabinett Waldenburg identified by K. Wöpke as having been in the Linck collection at the time of the *Index Musae Linckiani* (1783–1787) and those identified by the authors as the likely subjects of images in 1730 in the *Icones Serpentum et Viperarum* (1730) and volume IV of *Physica Sacra* by Scheuchzer (1735). Inventory numbers of specimens identified by a red shelf label (signifying presumed Linck specimens) indicated in bold. An asterisk (*) indicates an egregious mismatch of the specimen and its identification on the associated shelf label/stand, implying that they became dissociated from one another sometime after the reorganization of the collection in 1933–1934.

Shelf label	**Actual Identification**	**Inventory N°**	***Icones* plate**	***Physica Sacra* plate–figure**	**Figure in this paper**
Coluber vittatus	*Psammophylax rhombeatus**	**I2022A$_3$**	XXVI	739–7	plate 6a
Coluber domicella	*Helicops angulatus**	**I2018A$_3$**	no match	no match	
Coluber filaformis	*Ahaetulla prasina*	**I2017A$_3$** (2 specimens)	XIII	655–7	
Coluber melanocephalus	*Liophis lineatus**	**I2016A$_3$**	LIII	715–2	
Coluber angulatus	*Helicops angulatus*	**I2101A$_3$**	no match	no match	
Lacerta marmorata	*Polychrus marmoratus*	**I2003A$_3$**	no match	no match	
Lacerta calotes	*Calotes calotes*	**I2037A$_3$**	no match	no match	
Ameiva surinamensis	*Thecadactylus rapicauda**	**I2040A$_3$**	no match	no match	
Amphisbaena alba	*Amphisbaena alba*	I2046A$_3$	XXXIV	652–1	plate 6b
Boa constrictor	*Boa constrictor*	I2013A$_3$	XLIV	746–1	plate 7a
Crotalus durissus	*Crotalus durissus*	I2085A$_3$	XLIII	738–4	plate 7b
Coluber pullatus	*Thamodynastes pallidus**	I2072A$_3$	VIII	678–1	
Boa hortulana	*Corallus hortulanus*	no number, in stairwell	XVII	661–9	
Coluber naja	*Naja naja*	no number, in stairwell	XLII	749–9	
Dipsas dendrophila	*Boiga dendrophila*	I2068A$_3$	XLV	662–11	plate 8a
Coluber pallidus	*Helicops angulatus**	I2014A$_3$	LXXXIII	–	plate 8b

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Parenti RP (2008) A phylogenetic analysis and taxonomic revision of ricefishes, *Oryzias* and relatives (Beloniformes, Adrianichthyidae). Zoological Journal of the Linnean Society 154: 494–610

Sullivan J (1994) *Bufo boreas*. In: Fire Effects Information System (U.S. Department of Agriculture, Forest Service, Rocky Mountain Research Station, Fire Sciences Laboratory). Online at http://www.fs.fed.us/database/feis/animals/amphibian/bubo/all.html last accessed on December 28, 2009

Sztencel-Jablonka A, Jones G, Bogdanowicz W (2009) Skull morphology of two cryptic bat species: *Pipistrellus pipistrellus* and *P. pygmaeus* – a 3D geometric morphometrics approach with landmark reconstruction. Acta Chiropterologica 11: 113–126

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